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TABLE OF CONTENTS.

ENGINEERING NEWS OF THE WEEK.....225, 241

A Modern Dredging Plant (concluded from page 207) (*illustrated*)..... 226
Submarine Torpedo Boats for the United States..... 226
Tuberculation in Water Pipes..... 227
A Steam Bell Ringer for Locomotives (*illustrated*).. 227
The Sacramento Avenue Subway, Chicago, Ill. (*illustrated*)..... 228
Notes on Pile Foundations in Chicago..... 228
The Westinghouse Double-Acting Compound Engine (*illustrated*)..... 230
Test of Worthington Triple-Expansion Pumping Engine at the Concord (N. H.) Water-Works..... 230
A Stand-Pipe Success at East Providence, R. I. (*illustrated*)..... 237
Improved Tee Rail for Electric Street Railways (*illustrated*)..... 237
Relative Cost of Heavy vs. Reinforced Bridges..... 237
Railway Improvements for the World's Columbian Exposition—VII..... 238
A Convertible Skid or Truck (*illustrated*)..... 238
Canal Excavating by Hydraulic Power..... 239
Relation of Evaporation to Forests..... 239
The Pope Rail Joint (*illustrated*)..... 239
Sewage Purification in America: Chautauqua, N.Y. 239
The New York Railroad Commission's Finding on Recent Collisions..... 240
Tests of Paving Brick..... 241

PERSONALS, NEW PUBLICATIONS, SOCIETY PROCEEDINGS..... 231

EDITORIAL NOTES..... 234

Engineering Headquarters at the World's Columbian Exposition—"Track Exhibits at the World's Columbian Exposition," Correction—Commissioned Experts for Suits Involving Technical Questions—Brake Practice on the Long Island Railroad—The Latest Serious Collision.

EDITORIAL..... 235

Brakes for Electric Cars.

LETTERS TO THE EDITOR..... 236

Testing Machines and the Niagara Suspension Bridge—Iron Bridges Versus Tornadoes—Concerning Shear for a Uniformly Distributed Load—The Purchase of the Syracuse Water-Works—Artificial Fuel in France—Notes and Queries.

CONSTRUCTION NEWS..... 241, 244

Railways, Street Railways, Elevated and Cable Railways, Highways, Bridges, Tunnels and Canals, Water-Works, Artesian Wells, Irrigation, Sewers, Streets, Electric Light and Power, Contract Prices, Miscellaneous.

INDUSTRIAL NOTES..... 244

The New York Central 20-hour train to Chicago, the "Exposition Flyer," is proving a profitable investment again, though for a month or two during the height of the financial stringency its passenger list ran very low. The train reaching Chicago on Sept. 14 carried 100 passengers and had four sleeping cars. The fare by this train being $26, the gross receipts were $2,834 or $2.89 per mile for the 980 miles journey. The average passenger earnings per passenger train mile on the New York Central are only $1.25.

The Lake Superior Consolidated Iron Mines, organized in Duluth on Sept. 5, represents $300,000,000 paid-in capital and a gigantic iron trust. It will control a large proportion of the productive mining capacity for Bessemer ores in the United States, and includes in this control several ore-shippers' railways, a fleet of vessels of 60,000 tons carrying capacity and an ore-receiving port and railway from Lake Erie to the Pennsylvania furnaces. The men interested include John D. Rockefeller, C. W. Wetmore, C. L. Colby, Colgate Hoyt, W. C. Whitney and the Merritt Bros. Mr. L. Merritt is the President. The trust has a controlling interest in 11 to 14 Mesaba range mines, th Duluth, Mesaba & Northern Ry. with its ore docks at Duluth, large interests in the Gogebic mines, interest in the Cuban mines, the Amrican steel barge fleet of whalebacks, etc.

New Orleans, La., makes a step toward rapid transit in that city by selling at public auction the franchises of its prominent street railways, though these franchises do not expire until 1906. The Councils sold these franchises for 50 years, up to 1956, to the New Orleans Traction Co. for what is equivalent to $1,246,000, with $700,000 paid-in cash now. It is expected that electric traction will be introduced at once by the new company, a change impossible to the old corporations, owing to the short life of their concessions.

The Thirlmere Dam, for the increased storage of water for Manchester, England, will be completed in 1894, and is thus described in "The Architect": Thirlmere Lake is 533 ft. above sea level, and when the dam is completed its surface will be lifted 50 ft. more, or 583 ft., with an increased storage capacity of 80,000 million gallons. The area of the lake is 330 acres, and its greatest depth is 112 ft. The dam is being built at the north end and will be 50 ft. high by 800 ft. long. In order to secure a rock foundation the dam is curved in plan, like a flattened letter S, a rocky knoll dividing it into two parts and forming a strong center buttress. The highest point of the dam is about 100 ft. from foundation to summit. The dimensions given are a base 50 ft. wide reduced by a hollow curve to 20 ft. at the top. Along the top is a 16-ft. roadway. The inner side of the dam is faced with millstone grit and the outer face is a new redstone; the hearting is native rock imbedded in Portland cement. As the dam is at first to be used in raising the water only 20 ft. a discharge tunnel is constructed at that point, and another is built at the 50 ft. level for future use. The water is drawn from the south end for Manchester, and in its passage to that city passes through 50¾ miles of tunnel, 7 ft. wide by 7 ft. 9 in. high. One of these tunnels is 3 miles long. Mr. George H. Hill is Chief Engineer.

A state road convention was held at Sacramento, Cal., Sept. 7 and 8, at which papers by Mr. Wm. E. McClintock, M. Am. Soc. C. E., of the Massachusetts Highway Commission, and Mr. Ernest McCullough, of San Francisco, were read. A resolution favoring long term bonds to meet the cost of highway improvements failed to carry, it being thought best to leave this matter to the individual counties. Among the conclusions which seem to have been generally agreed upon were the following: That sprinkling is an essential to good road maintenance; that the width of tires should be regulated to the weight of the load; that the contract system of road construction is desirable; that the ten-block road-numbering system is advantageous; that trunk roads should be built at county expense and laterals at district expense.

Competitive designs are invited until Nov. 15 for a $500,000 library building at Milwaukee. The architect whose plans are accepted will be given charge of the works on a 5% commission. The four plans next in order of merit will be purchased at $500 each. Information may be obtained by addressing the Board of Public Library and Museum, Milwaukee, Wis.

The most serious railway accident of the week was a rear collision on the unfortunate "Big Four" (Cleveland, Cincinnati, Chicago & St. Louis, resulting in the death of 8 persons and the injury of 22. Further particulars are given on our editorial page.

The new U. S. gunboat "Castine" has made a trial record of 15¾ knots corrected speed, with 16.42 knots actual speed. This makes the "Castine" faster than her sister ship the "Machias," which made 15.46 knots corrected speed in her recent trial. The "Castine" is a steel gunboat, 190 ft. long on load-line, 32 ft. beam and 12¾ ft. mean draft. The displacement is 1,050 tons and she has 1,600 aggregate horse-power with vertical triple expansion engines. The coal capacity is sufficient for steaming 4,668 knots at a 10-knot rate per hour. Her main battery is made up of eight 4-in. rapid-fire guns, four 6 pdrs., two 1 pdrs. and two Gatling guns.

A new magazine rifle is to be selected for the United States Navy. The Small Arms Board has decided that the naval service requires a gun of smaller caliber than 30, the army type, and recommends a rifle of 23½ calibers, or 6 mm. The Board decides that the projectile from such a gun will have a flatter trajectory, thus doing away with sights, greater velocity and greater range, lighter ammunition and greater accuracy. The Navy Department will furnish the barrels and ammunition, and American inventors are called upon to supply the breech mechanism and stock. The Board is experimenting with a barrel of steel with 25% of nickel in it.

The proposed abolition of grade crossings in Chicago is making some progress, if we may believe newspaper reports. It is stated that the Lake Shore & Michigan Southern and the Chicago, Rock Island & Pacific companies will ask for a depression of the street grade at crossings of only 4 ft., and will agree to bear nearly the entire cost of the work. Mr. Geo. H. Ellers, Consulting Engineer to Mayor Harrison, in special charge of the grade crossing problem, is making surveys of all the railway lines entering the city, and it is expected that he will submit a report before the end of the month.

The 520 ft. swing span of the bridge across the Missouri River between Council Bluffs, Ia., and Omaha, Neb., was completed Sept. 14. The span is designed to carry a double track railway, two roadways and two sidewalks, and is the longest and heaviest swing span ever constructed. It was constructed and erected by the Phoenix Bridge Co., of Phoenixville, Pa., John Stirling Deans, M. Am. Soc. C. E., Chief Engineer. The bridge was built for the Interstate Bridge Co., J. A. L. Waddell, M. Am. Soc. C. E., Chief Engineer.

Complete designs are called for, through the Austro-Hungarian Consul-General in New York, for two steel or iron highway bridges over the Danube at Budapest, and though we made note of the competition in our issue of Sept. 7, we give a somewhat fuller statement from the official documents. These bridges are not only to be stable in construction and correct in technical design, but they must also be aesthetically worthy of their place in the Hungarian capital. It is desirable that the bridges be designed for single spans of 1,042 ft. and 1,065 ft. But if such designs would call for an expenditure of considerably more than 5,000,000 crowns (about $1,050,000) for each bridge, one large and two smaller spans may be used. Plans should be presented to the Royal Hungarian Minister of Commerce before Jan. 31, 1894. They will then be examined by a commission of experts, and a prize of $6,250 will be awarded for the best plan, and $4,150 will be given for the second best plan. In case the plan will admit of satisfactory construction for not much exceeding the estimate of $1,050,000 for each bridge, an additional prize of $2,100 will be awarded. The Minister also reserves the right to buy for $1,050 any plan not taking a prize. The full conditions (in French), with plans of the sites, can be obtained by applying to Mr. T. A. Havemeyer, Austro-Hungarian Consul-General, 33 Broadway, New York City.

Accidents from electric cars in Brooklyn during the period from Jan. 1 to July 11, 1893, amounted to 15 persons killed and 54 injured, according to the statement of an attorney for the Brooklyn Union Elevated R. R. before the State Railway Commission. He also stated that only 4 persons were killed and 37 injured by horse cars during the same period.

Serious forest fires have raged in Northern Wisconsin during the present month, and it is estimated that the value of the timber destroyed reaches $6,000,000. The extent of the damage is greater than in any year since 1871, when Peshtigo was destroyed.

A Southern Pacific freight train ran into an open draw at Harvey's Canal, near New Orleans, on Sept. 10. The draw was protected by Hall automatic signals, which were properly set at danger, but the engineer ran past them at a high rate of speed and went into the canal with his engine.——A condemned bridge over the Miami & Erie Canal at Amanda, O., fell on Sept. 12 under a four-horse load of lumber.

The gas-holder of the East River Gas Co. is not, strictly speaking, the largest gas-holder in the world, as intimated in our issue of Sept. 14; though Mr. D. L. Hough, the engineer of the gas company, writes us that it is the largest built to date upon this continent. Mr. Hough goes on to say that it will have a metal tank which he believes will be the largest in the world. This tank will be 190 ft. in diameter and 48 ft. 9 in. deep. The holder will be of the four-lift type and will have a capacity of upward of five million cubic feet. From the bottom of tank to top of guide frames is 240 ft., making the highest structure of this kind in the world.

The feasability of connecting Lake Winnipeg by canal with the Mississippi River is again being examined into by Congressmen Boen and McCleary, of Michigan, in consultation with the U. S. engineers, says a St. Paul item. The route suggested is by way of Lake Traverse and Big Stone Lake. The estimated cost of connecting these lakes and improving the Minnesota River and the Red River of the North sufficiently to allow the passage of light draft steamboats is $1,000,000.

The U. S. Navy Department, say Washington press items, has made a radical change in the rules regulating speed trials of U. S. vessels. The new rules specify that no higher tests of the boilers and machinery will be permitted than those easily obtainable under ordinary working circumstances. These rules thus forbid the use of fancy coal, firemen of extraordinary skill, liquid fuel and unusually high steam pressure. The department realizes that it has been paying heavy premiums on speed records in excess of contract requirements which were practically mere spurts, not liable to be repeated in actual service. As five new war ships are to be tested within the next six weeks this new ruling is not pleasing to the shipbuilders.

A bicycle record of 26 miles in 50 minutes and 52 1-5 seconds was made in the late races at Springfield, Mass. A speed of 26 miles per hour was considered good enough for a locomotive not so many years ago, and the best trotting record for 20 miles is, we believe, 58 minutes 25 seconds, or about 12 minutes slower than the record made by the man on the bicycle.

A MODERN DREDGING PLANT.

(With Inset).

(Concluded from p. 207.)

Taking up in detail the design of the machine, the hull, which has to sustain the weight of the machinery and the heavy strains due to its working, is merely a rectangular box, with the rear end (which is the prow when the dredge is being towed) sloped at an angle of 30° from the vertical. The flat bottom gives great flotation with light draft, and the rectangular shape makes the hull very cheap to build or repair. The hull trussing consists of two vertical Howe trusses at the sides of the hull, 8 ft. in depth, and two steel trusses 16 ft. 8 ins. in depth, which form the main framework for distributing the strain due to the working of the machinery. A horizontal steel truss joins the upper chords of these main vertical trusses, as shown by the drawings. The timbering and skin of the hull supports and braces the lower chords of the vertical trusses and they are fastened by a bridle to every floor timber. The timbers of the hull are of oak. The planking which forms the skin of the hull is 3-in. hard pine except on the front 15 ft. of the hull, which is of 8-in. thick oak, and the fender streak running entirely around the hull, which is of oak, 5 ins. thick. The deck planking is also of 3-in. pine.

It will be noticed that the dredge has but a single skin of planking; and the whole hull is one open chamber. Any injury to this skin, therefore, which starts a leak that the pumps cannot handle must send her to the bottom. As the dredge draws only 3 to 4 ft., of course the dredge is not liable to injure her bottom except in water so shallow that she can readily be pumped out and floated. Still it is worth while considering whether the extra expense would not be justifiable of making water-tight compartments of the two side wings of the hull, shown on the cross-section. These are practically free of machinery and could be closed up at small extra expense.

To hold the dredge steady when at work and practically sustain the whole load due to the working of the dipper, two heavy spuds, shod with steel, are let down, one on each side near the bow. These spuds are built of two oak timbers bolted together, making a stick 2 ft. square and 45 ft. long. To prevent the dredge hull from being swung around by the side thrust of the dipper, a trailing spud 16 ins. square is mounted at the stern. The machinery for handling these heavy spuds forms one of the features of dredge construction which are peculiar to it, and is of considerable interest. When the dredge is brought into position, the spuds are let down, their descent being controlled by a friction brake operated by a foot lever. Each spud carries a heavy steel rack 24 ft. in length, with shrouded teeth of 2½ ins. pitch. When the spuds come to rest on the bottom, dogs are thrown forward engaging with ratchet wheels on a cross-shaft which carries a pinion meshing with the rack. The dredge is then set to work and the side thrust of the dipper lifts one side or the other and the dogs hold fast whatever elevation is gained. To lift the spuds when the dredge is to change position, each forward spud has a steam cylinder of 20 ins. diameter connected by a friction grip to the spud. When steam is turned on, this grasps the spud and lifts it to the limit of its stroke, no matter how soft and sticky a bottom it may be resting in. The dogs hold whatever is gained; the steam is shut off; the piston falls; and the operation is repeated. A similar but smaller cylinder is supplied for the trailing spud.

To facilitate releasing the dogs before lifting the spuds when they are under a very heavy strain and are held fast by the ratchet teeth, the dogs are made with a clevis, into which a lever can be placed to pry the dog out. The band brake on the shaft then prevents the spud from going down with a run. If the pinion engaging with the rack was the sole support by which the dredge was suspended on the spuds when at work, rapid wear of the pinion and of the rack at the points corresponding to usual depths of working would ensue. To prevent this the casting which carries the pinion carries also a short rack of six teeth, and when the dredge has raised upon the spuds this rack is moved by an eccentric to engage with the rack on the spud. The square toothed pinion with ratchets on the ends of the shaft, seen in the drawings, is for use in lifting the spud by hand in case the steam cylinder should be out of order. The trailing spud machinery is considerably simpler, as the spud is much lighter and sustains comparatively little strain. Reference to the drawings will show how the frame of the hull is strengthened around the forward spuds to take the strain due to their work.

Turning now to the working machinery of the dredge, the dipper and the arm which works it are swung between two steel trusses which are pivoted at their rear to the mast, as shown. The whole weight of all this forward gear is carried on the swing timbers, two oak timbers 16 ins. deep and 14 ins. wide, secured to the main frames of the hull. The dipper man stands just above these timbers and back of the mast and operates the band brake on the boom wheel which, when slacked off, allows the dipper handle to run up or down, according to its position and the pull of the chains upon it. The dipper man also dumps the dipper by pulling the rope attached to the dumping latch.

The other motions of the dipper are controlled by the engineer, who can swing the boom to one side or the other so that the dipper may dig or dump at any desired spot by running the swinging engines either forward or backward. These engines have 8×12-in. cylinders, and reversing valve gear. The manner in which motion is conveyed from them to the large sprocket wheel which swings the boom is plainly shown by the drawings.

The hoisting chain and backing chain run from the dipper to the winding drums of the main engine, the first having its pull on the dipper trebled by running through a block attached to the dipper bail and then over a sheave on the boom and back to the dipper bail. Both the backing chain and the hoisting chain are guided over sheaves and rollers in such a manner as to avoid any kinking or bending of the links no matter what the position of the boom or the dipper handle.

The feature of principal interest in connection with the main winding engines is the system of friction clutches by which the drums are controlled. The engines have 14×16-in. cylinders and are fitted with a simple valve motion; as they move always in the same direction, no reversing gear is necessary, and they are controlled entirely by the throttle. On the engine shaft is a 15-in. pinion with 16-in. face engaging with a 7-ft. gear wheel on the main drum shaft. This drives a 4-ft. pinion on the backing drum shaft. The face of each of these gear wheels carries a cone and the ends of the winding drums on each shaft are enlarged to fit these cones.

Thus a powerful friction clutch is formed, and as the drums are not keyed to their shafts but revolve freely upon them, they can be rotated or left idle by moving them toward or away from the gear wheels. This transverse motion, causing the friction clutches to engage or disengage is effected by screw threads of steep pitch cut on the sleeves in which the drum shaft ends furthest from the gears are run. These sleeves carry arms, which, when moved in one or the other direction, effect the engagement and release of the clutches. The arm on the backing drum shaft is moved by a rod connected to a lever similar to a reverse lever, which the engineer operates. To handle the much heavier hoisting clutch, however, an auxiliary steam cylinder is employed, as shown in the drawing. A three-way cock controlled by a rod reaching to the engineer's platform lets steam into one end or the other of the cylinder as desired, and a rack on the piston rod engaging with a segment of a gear on the arm transmits the motion to the screw sleeve.

It is evident that if steam should be turned full on this cylinder it would force the clutch to or from its seat so suddenly as to endanger the connections. To check this sudden movement a cylinder is placed to the right of the steam cylinder with a piston mounted on the same rod as the steam cylinder piston. This cylinder is filled with oil and a by-pass pipe connects its two ends. Throttling cocks in this pipe regulate the movement of the oil, and by adjusting these any desired rate of movement of the steam cylinder may be secured.

The clutch above described is used for hoisting the dipper; but as it would not let it down smoothly a band brake is attached to the main drum shaft, and is operated from the engineer's platform by a foot lever.

The boiler which furnishes steam for all the engines on the dredge is of locomotive type, and has 1,000 sq. ft. of heating surface and 20 sq. ft. of grate surface. The feedwater is supplied either by a Hancock inspirator or by a Worthington pump. The latter is so connected that it can be used independently for washing decks, fire purposes, etc. To keep the hull free of bilge water and take care of any small leaks two 3-in. steam jet pumps are placed in the hull forward, and one is placed aft. Th boiler feedwater is passed through a copper coil feedwater heater before entering the boiler. The exhaust from the main engines is controlled by a three-way cock so that the exhaust steam after passing through the heater can be turned into the chimney, creating a forced draft or sent outside at pleasure.

For traversing any long distances a tug is, of course, used; but if necessary the dredge can travel at some speed without any assistance by merely using its dipper as a paddle, and it is, therefore, able to move itself about as necessary on its working grounds. The way in which this is done is simple. The dipper is allowed to run out over the water as far as the handle will reach, and the engineer then hauls in full speed on the backing chain while the dipper man lets the dipper handle run up as it swings down toward the vertical to avoid striking the bottom. By swinging the boom to one side or the other the direction of motion can be altered, and motion can be effected in the reverse direction by paddling with the dipper the other way.

The dredge is also equipped with winding spools for handling scows alongside. These are driven by bevel gear from a transverse shaft which derives its motion by a sprocket chain from the backing drum shaft. In operation the scows are brought up from the rear. A line is attached and the scow is warped ahead and allowed to go past the dredge by her own momentum till her rear pocket is in the right position for the dipper to fill. She is then made fast and warped back by the same winding spool as one pocket after another is filled.

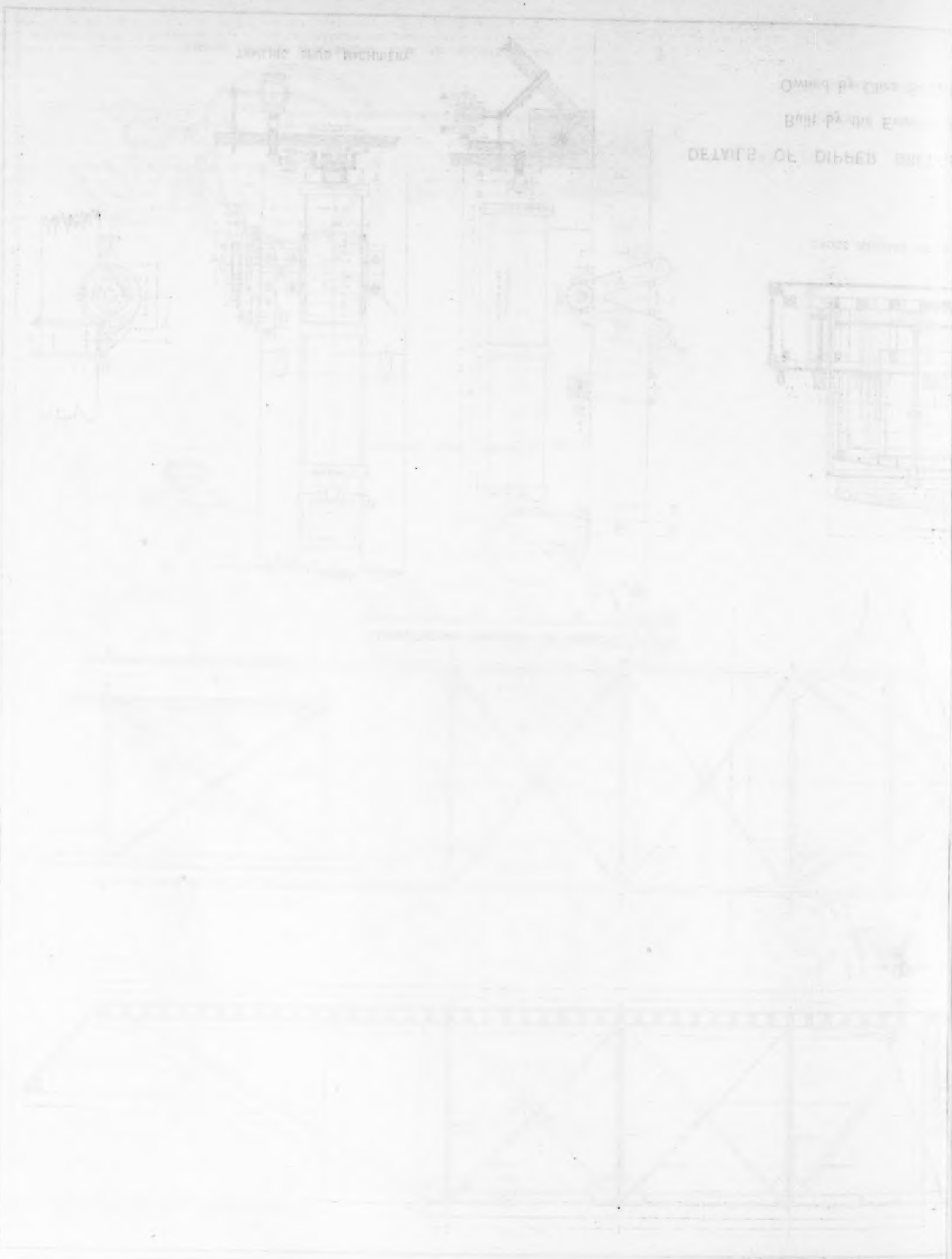
The dredge when equipped for work draws 4 ft. 6 ins. forward and 3 ft. aft. Her dipper has a capacity of 3 cu. yds. and can dump at a point 52 ft. from the center of the mast, and dig material from a depth of 27 ft. Working 10 hours per day in fair material she can dump 1,800 to 2,600 cu. yds. into scows, or place about 2,000 cu. yds. on the bank. Reckoning 2½ cu. yds. as the average dipper load, this is at the rate of one complete movement every 45 seconds when placing the material in bank.

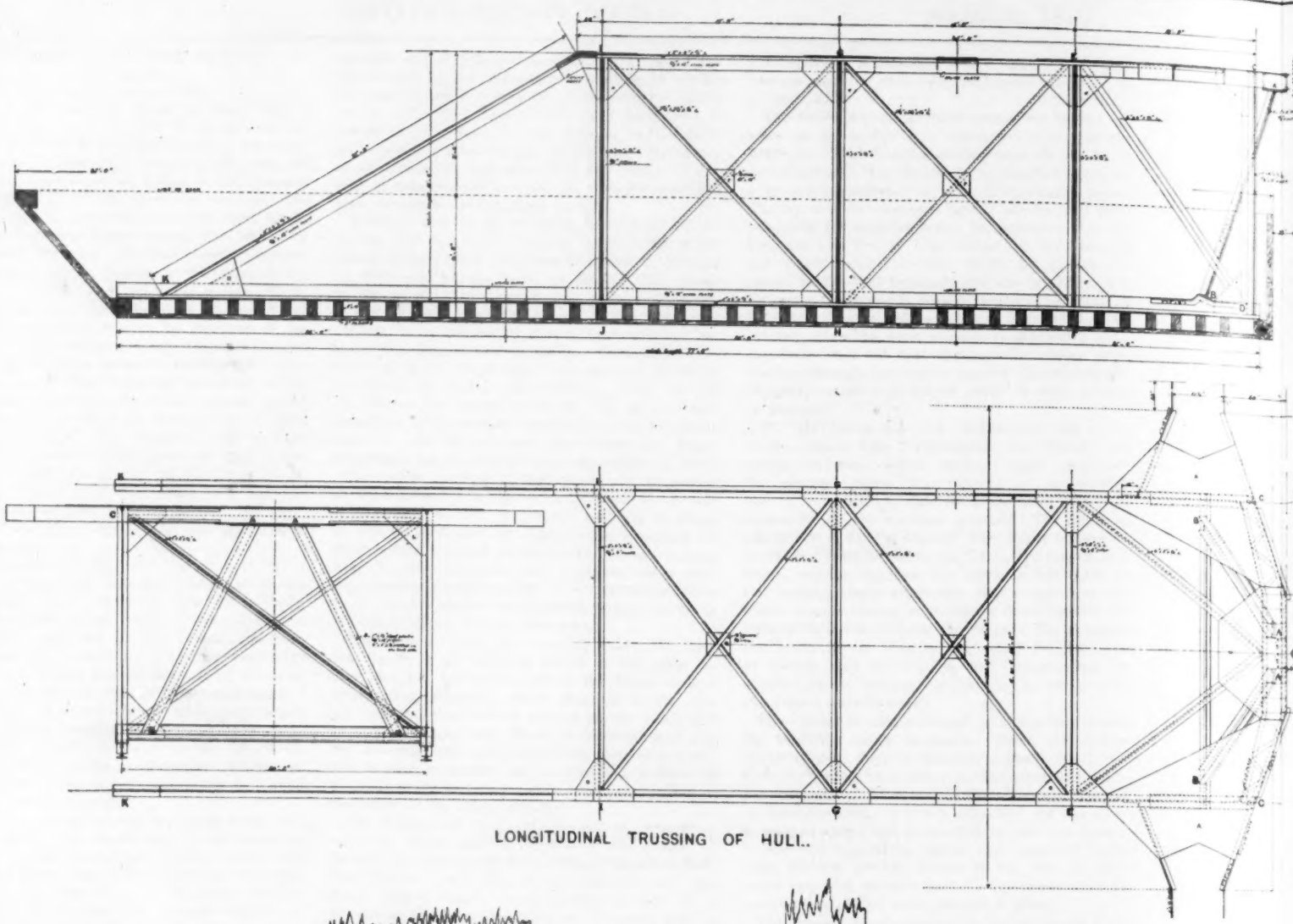
The character of the material in hull and frame we have already referred to. The racks on the dipper handle and on the spuds have shrouded teeth and are made of cast steel. The gears on the hoisting drum and on the backing drum shafts are cast iron with teeth shrouded half their depth, and the pinion on the engine shaft which drives them is cast steel.

We are indebted to the Excelsior Iron Works of Chicago, the builders of the dredge, for the drawings from which our illustrations have been prepared.

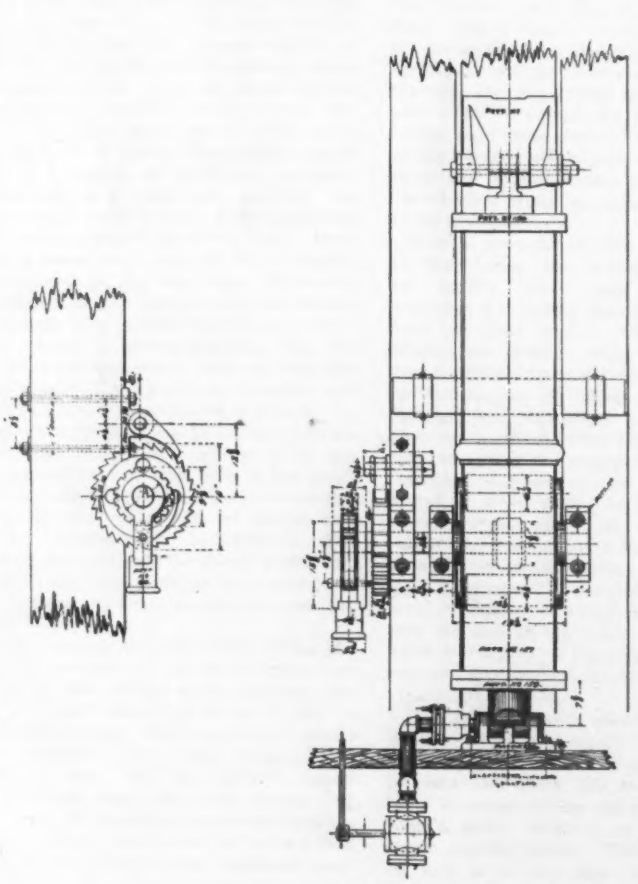
SUBMARINE TORPEDO BOATS FOR THE UNITED STATES.

As announced in our issue of Aug. 17, the Navy Department has had gratifying success in its search for a submarine torpedo boat of American invention. The torpedo boat invented by Mr. John P. Holland, of the John P. Holland Torpedo Boat Co., 120 Broadway, which has been practically adopted by the Department, is a cigar-shaped vessel with sharp prow and stern, designed to run either on the surface or at any desired depth; its shell is proportioned to safely withstand the hydrostatic pressure due to a depth of 70 ft. The shell will be 80 ft. long and 11 ft. in diameter at the center. The motive power will be twin quadruple-expansion engines of 1,000 HP. driving twin screws and working with an economy of about 18 lbs. of steam per I. HP. The speed of the vessel when driven by the engines will be 16 knots when running on the surface of the water, 15 knots when submerged to a depth at which only a small area of the upper part of the

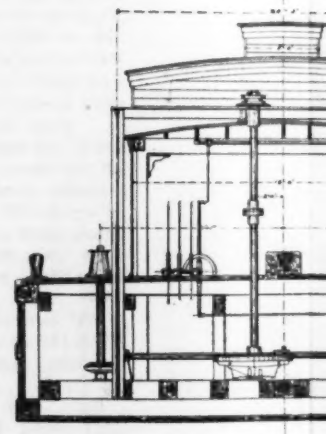




LONGITUDINAL TRUSSING OF HULL.



TRAILING SPUD MACHINERY.

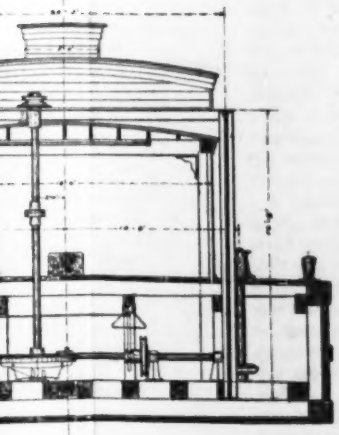


CROSS SECTION OF HUL

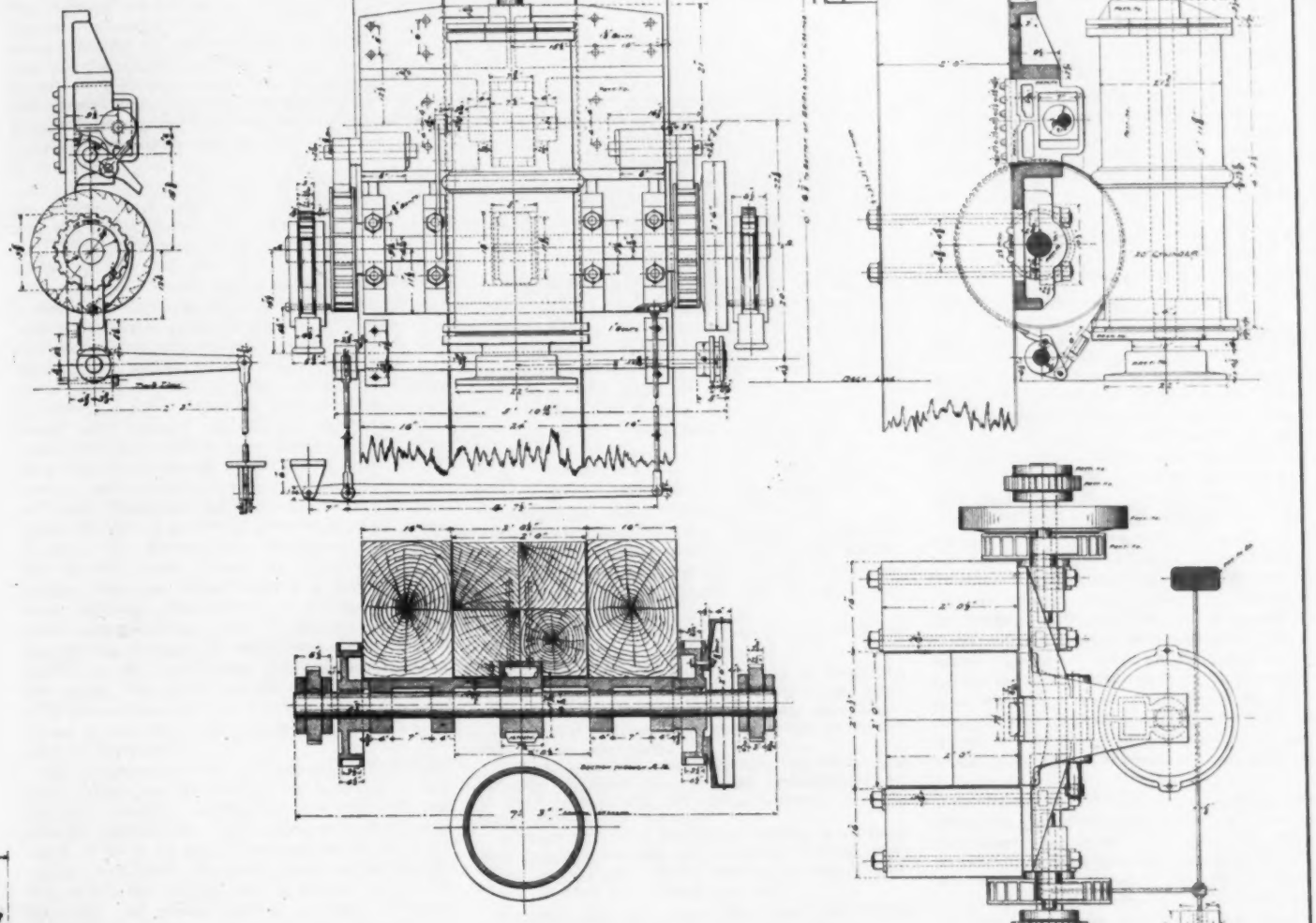
DETAILS OF DIPPER DREDGE,

Built by the Excelsior Iro

Owned by Chas. S. Barke



ON OF HULL OF DREDGE.

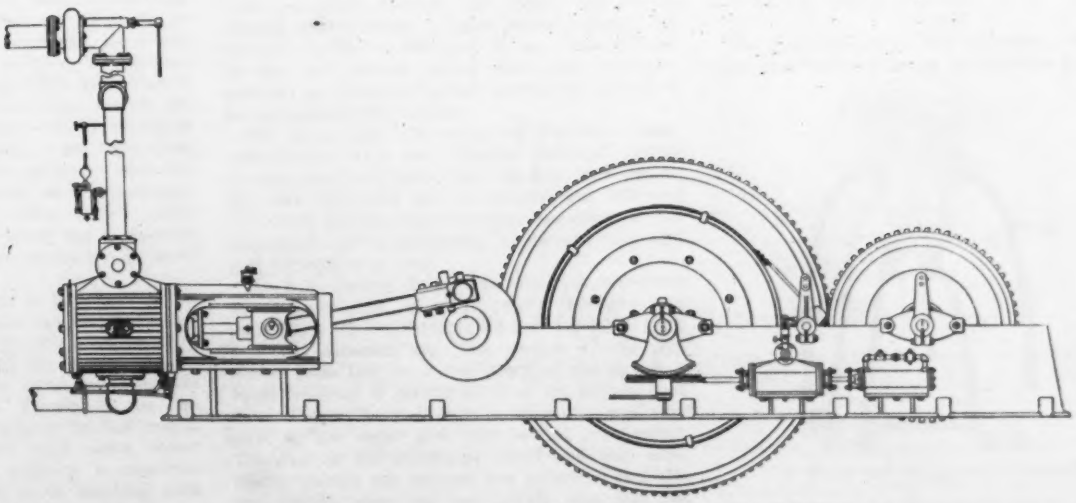


FORWARD SPUD MACHINERY.

DREDGE, 2,000 CU. YDS. CAPACITY,

xcelsior Iron Works, Chicago, Ill.

s. S. Barker, West Superior, Wis.



SIDE ELEVATION OF MAIN ENGINE AND WINDING DRUMS.

hull is exposed, and 8 knots when running under water, driven by electricity from storage batteries. The vessel carries coal supply sufficient for a 15-hour run on the surface, and her storage batteries will enable her to run for 6 hours entirely submerged.

Of course the water is the chief reliance for protection against an enemy's shot and shell; but a conning tower with 8-in. plate is also provided. If desired the boat can be submerged so that nothing but this tower projects from the surface of the water. When nearing the enemy the entire boat can be submerged just beneath the surface and the commander who occupies the conning tower can still obtain a view of his surroundings. The vessel's armament is determined by the Navy Department and the sole weapons are automatic automobile torpedoes; two expulsion tubes are fitted at the bow.

The most interesting details in connection with the vessel are the appliances used in submerging her, and the apparatus for steering automatically in a straight course while submerged. Suppose while running on the surface of the water with the smokestack and air shaft erected, it is desired to dive. As soon as the signal is given, valves are opened permitting the air in certain ballast chambers to escape and the water to enter; the boat rapidly settles in the water until only the upper part of her hull projects. At the same time the blower is stopped and the fireproof doors to the ashpit and furnace are closed. The telescopic smokestack and airshaft are lowered and the covers of the apertures through which they pass are swung around and clamped in place. These operations are rapidly performed and the entire hull being then closed airtight, it is directed downward at an angle of about 10% by deflecting horizontal plane rudders at the stern. When the desired depth is reached these are turned back to a horizontal position and are connected to an automatic device which maintains the vessel at a constant depth beneath the surface by slight movements of the rudder as the vessel rises above or sinks below this depth. The propellers are run by the engines until steam from the boilers is run off, and motors taking current from the storage batteries are then used for propulsion.

The arrangements for ventilation are very complete. When on the surface air is taken in and expelled through a ventilating tube projecting beside the smokestack. When lying submerged at a depth of 50 ft. or less, a pipe can be raised to the surface and fresh air drawn down by an electric fan, while the vitiated air is forced out by an air pump. At greater depths, or when in motion beneath the surface, fresh air is supplied from compressed air reservoirs, where it is stored under a pressure of 2,000 lbs. per sq. in., the quantity being sufficient for an immersion of 10 hours. The vitiated air is expelled as before explained.

A problem whose solution is of much importance to the crews of future submarine boats, is the complete control of the vessel in a horizontal plane, so that she shall never dive lower than the depth at which her hull will safely sustain the pressure. In the Holland boat, it is to be noted that the vessel is always forced below the surface; her reserve buoyancy, when diving, is about 1,300 lbs.; hence, if her machinery stops she will at once rise to the surface. Besides this two water ballast chambers can be almost instantly emptied at any time when necessary by opening a valve connected with the compressed air chamber, and the reserve buoyancy can be thus about doubled. Other ballast tanks, containing about two tons of water can be emptied by an electric pump, or in an emergency by hand pumps.

On the other hand, in case it is desired to lie stationary beneath the surface, the buoyancy can be reduced to about 300 lbs. by admitting water to two additional ballast tanks; an anchor can be dropped or the vessel pulled down by downhaul screws to the desired depth. Finally, in the contingency of damage to the plates of the hull and to the inner shell by collision with some object causing an inrush of water sufficient to overcome her buoyancy, the crew are to be provided with cork jackets and with diving helmets. As the vessel fills with water the air in the hull will be compressed and an equilibrium will be reached between the inside and outside pressures. The manhole in the hull is then opened and the men rise to the surface. This will be the fifth of Holland's boats. The first was built in 1877 and experimented with on the Passaic River, at Paterson, N. J. The second was built in 1879 and was the most successful of its kind. The third was built in 1883 and was lost by Holland's business partner off Whitestone on the Sound. The fourth, called the Zalinsky boat, was built in old Fort Lafayette and was wrecked owing to bad management during its launch.

The submarine boat invented by Mr. Geo. C. Baker, of Washington, is similar to the Holland boat in many of its features, and has been built and tested on Lake Michigan, while the present Holland boat is still on paper. An interesting detail of the Baker boat is that the propellers are at the sides instead of at the stern, and can be turned either vertically or horizontally to drive the boat ahead or to simply submerge it when not in motion. The propellers are driven by bevel gearing from a transverse shaft.

TUBERCULATION IN WATER PIPES.

The extent to which ordinary tar coating applied to iron water pipes will prevent tuberculation has recently been exhaustively discussed by a number of members of the American Society of Civil Engineers. The basis of the discussion was a paper by Mr. Jas. Duane, M. Am. Soc. C E, read before the society Feb 1, 1893 (see Eng. News, Feb. 2, 1893, for abstract*), and published in the society's "Transactions" for January, 1893. The discussions were printed in the April number of the "Transactions" and are abstracted below:

Mr. Duane's paper, it may be stated in way of review, compared the condition of two 48-in. cast iron water mains in New York city, laid under similar conditions, except that one was tar coated and the other was not.

Mr. Duane's deductions may be repeated as follows:

(1) An uncoated main conveying water of the general chemical composition of the Croton will become badly tuberculated in seven years, or probably much less.

(2) That having reached a certain stage no further deterioration takes place.

(3) That in a 48-in. main (uncoated) the discharging capacity is reduced about 30% (by tuberculation); or, to put it another way, tar coating at present prices is worth about $20,000 per mile.

(4) That a properly applied tar coating is an absolute protection against tuberculation, a 48-in. main after eleven years' service showing as high a coefficient as when first brought into use.

In discussing the paper Mr. Chas. B. Brush, M. Am. Soc. C E., stated that in the last few years he had made several examinations of 24, 20 and 14-in. coated pipe which had been in constant use and found little or no indication of interior tuberculation. A coated main in use for 20 years was found to be free from tuberculation. With properly coated mains there need be but little fear of tuberculation. The use of pipe without tar coating is now practically obsolete. Mr. Brush and others thought that perhaps leakage would account for some of the loss of efficiency in the uncoated pipe. To this Mr. Duane replied that after thorough personal examination he had concluded that there was no appreciable leakage.

Mr. Brush gave the results of experience with pipe treated with the "rustless process," which showed that such pipe, used by him, had rusted. He was convinced that no preparation but coal tar would prevent tuberculation, and that in this connection cast is preferable to wrought iron, and soft to hard cast iron.

Mr. L. L. Tribus, Assoc. Am. Soc. C. E., described the tuberculation of a 20 × 80-ft. wrought iron stand-pipe, observed during its removal after eight years of constant use. The service of the pipe varied from full for a few hours of the day to a rapid lowering to within 15 ft. of the bottom each day. The water was from a river and was very hard at low water and very soft at high water. The part of the stand-pipe which had been most nearly always wet showed few tubercles and also the portion near the top, which was wet but a small part of the time. The remainder of the pipe had tubercles from ½ to ¾ in. in diameter ¼ to ½ in. in height, shaped like a hollow cone, and were easily detached by a slight jar.

Mr. Desmond FitzGerald, M. Am. Soc. C. E., stated that some waters have practically no effect upon pipe, whether the latter is coated or not. Boston water, which is very similar to Croton, has a decided effect on cast iron pipe, but as stated in Mr. Duane's second proposition, given above, the tuberculation does not increase after a certain time. Propositions (3) and (4) of Mr. Duane's paper, Mr. FitzGerald thought must be received with caution. Certainly they cannot apply to Boston water.

Mr. Dexter Brackett, M. Am. Soc. C. E., also questioned Mr. Duane's conclusion that "a properly applied tar coating is an absolute protection against tuberculation," unless it be that as ordinarily furnished pipe is not properly coated. Coated pipes in the vicinity of Boston, Mr. Brackett stated, are generally pitted with tubercles after 10 to 15 years of use.

In reply to the above statements of Messrs. FitzGerald and Brackett, Mr. Duane stated that in New York coated mains from 6 ins. to 6 ft. in diameter showed no tuberculation after 30 years of use, so far as he remembered.

Mr. Brackett said that in Boston from 1848 to 1868, with the exception of a few hundred feet, all the pipe laid was uncoated and that the entire inner surface of this old pipe is covered with from ¼ to 1 in. of tubercles; moreover, tubercles were found in all the large pipe examined only four years after the pipe was laid. The Boston experience was also that the growth in an uncoated pipe is at first very rapid, practically ceasing after from 7 to 10 years.

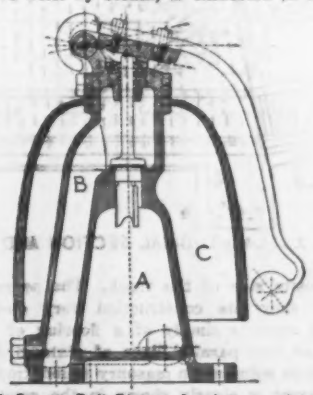
In 1876 58,000 ft. of Boston 6-in. pipe was scraped to free it of tubercles at a cost of 14 cts. per ft. and 20,300 ft. of 12-in. at 20.6 cts. per ft., including a royalty of 5 cts. per ft. for the right to use the scraper. Experiments in Boston showed that some tuberculated 6-in. pipe delivered from 25 to 35% of the quantity to be expected from a clean coated pipe under the same head and that by removing the tubercles the discharging capacity of the pipe was more than doubled. With 4-in. pipe, clogged with tubercles, a head of 25 ft. was required to deliver the same quantity of water as would have flowed through a clean pipe under a 1-ft. head.

In Engineering News of Sept. 17, 1881, there was given an illustrated description of the internal corrosion or tuberculation of cast iron pipes at Aberdeen, Scotland, and the methods employed for its removal. A paper describing the removal of corrosion or tuberculation from water mains in Halifax, N. S., was read before the American Society of Civil Engineers in March, 1882, and a brief abstract given in our issue of March 18, 1882. The full paper, with illustrations, appeared in the "Transactions" of the society for April, 1882. In our issue of Feb. 25, 1888, will be found a paper "On the Action of Boston Water on Certain Sorts of Service Pipe."

*The formula $V = c\sqrt{RI}$ was, by a typographical error, made to read $V = c\sqrt{R}$ in the abstract.

A STEAM BELL RINGER FOR LOCOMOTIVES.

The Latowski steam bell apparatus, for ringing locomotive bells by steam, is exhibited in the German section of the Transportation Department of the World's Columbian Exposition. As shown by the accompanying cut, steam is admitted to the



A Steam Bell-Ringer for Locomotives.

chamber A through a small aperture, and raising the valve escapes by a larger aperture into B. As the exhaust is greater than the admission, the valve is given a continuous movement, causing a series of regular strokes to be given to the bell C by the hammer. The bell is preferably mounted on the roof of the cab, with a bed of felt where it is screwed to the support so as to diminish the sound within the cab. In the arrangement shown in the cut the steam does not escape directly from the chamber into the atmosphere, but is led by a tube from B to the smokestack. The apparatus is used on the German state railways and by many railway companies in Germany. Messrs. Schaffer & Budenberg, 45 John St., New York city, have the agency for the United States.

THE SACRAMENTO AVENUE SUBWAY, CHICAGO, ILL.

With the rapid growth of our larger cities and towns the necessity is becoming greater each year for the abolition of grade crossings and the provision for the increasing street and railway traffic on different levels by the construction of subways and overhead bridges, and there is consequently a constantly growing demand upon engineers for the economical design and construction of this class of work. For this reason the example of subway construction, now being carried out in several places in the city of Chicago, which we illustrate in the accompanying cuts, is of considerable interest to engineers who may be called upon to design such structures.

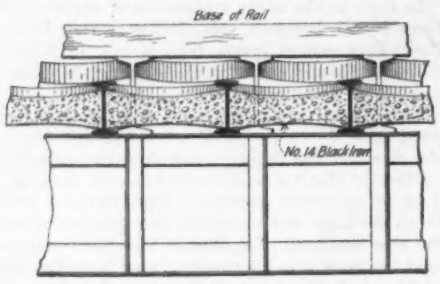


Fig. 1. Longitudinal Section Through Roof of Sidewalk.

This particular subway was designed to carry Sacramento Ave. under the tracks of the Chicago & Northwestern Ry., and afford access to several manufacturing plants, where formerly a detour of nearly a mile was necessary to reach them from the opposite side of the track. The several illustrations show its construction very clearly. In brief, it consists simply of a flooring of I-beams resting on two parallel lines of plate girders carried by iron columns on masonry foundations. This arrangement is clearly shown in the general plan and section, in Figs. 1 and 2. Between the two lines of plate girders is the roadway 20 ft. wide and on the outside of each at a higher level is a 6-ft. sidewalk. This arrangement of the columns and sidewalk is shown in Fig. 3, drawn from a photograph taken by Stadler & Jorgersen, Unity Building, Chicago, Ill. The sidewalks are reached from the street level by stairways at each end of the subway.

The I-beams carrying the tracks over the roadway are 15-in. steel beams, 22 ft. long and weigh 80 lbs. per lin. ft., and those over the sidewalks are 10-in. steel beams 8 ft. 6½ ins. long and weigh 25.5 lbs. per lin. ft. These I-beams are placed 2 ft. apart c. to c. and arched between with concrete, which was found to be much cheaper than brick. About 3,500 cu. ft. of 1 Portland cement, 2 sand and 3 limestone scalings concrete were used for the arches. The arches are painted on the inside with two coats of white lead and the subway is lighted by the city with gas lamps throughout. The railway tracks are laid on longitudinal timbers resting directly on the top of the I-beams. At each end of the subway there is an 18-ft. bridge of I-beams over the subway approach to permit the passage of teams from one side of the street to the other. The passage at each side of the subway approach is 21 ft. 6 ins. wide, including the sidewalk. The surface drainage from the railway tracks is carried by pipes to the catch basins in the streets.

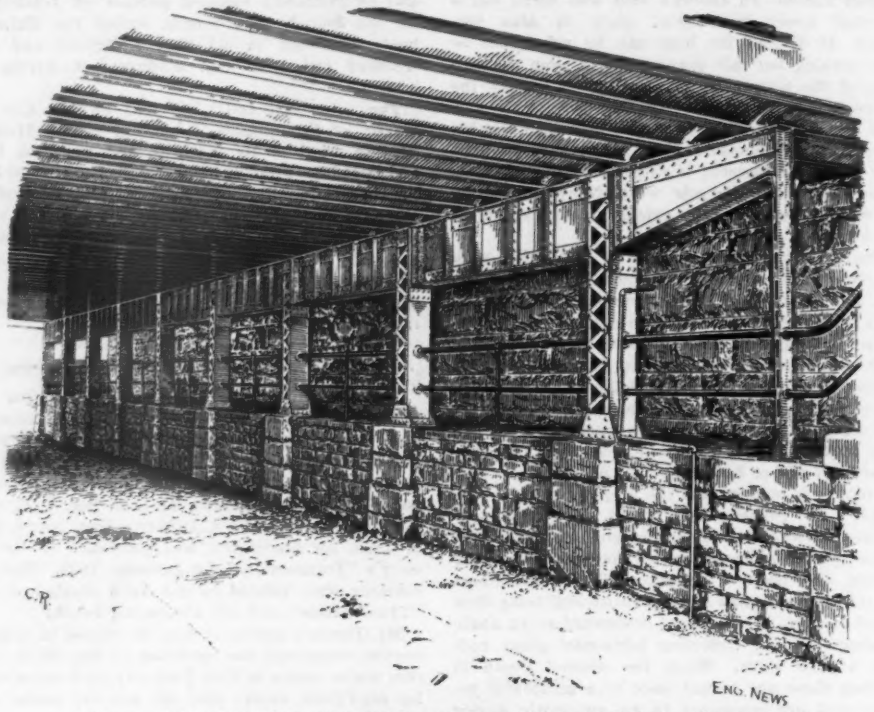


FIG. 3. VIEW SHOWING COLUMNS AND GIRDERS SUPPORTING THE ROOF.

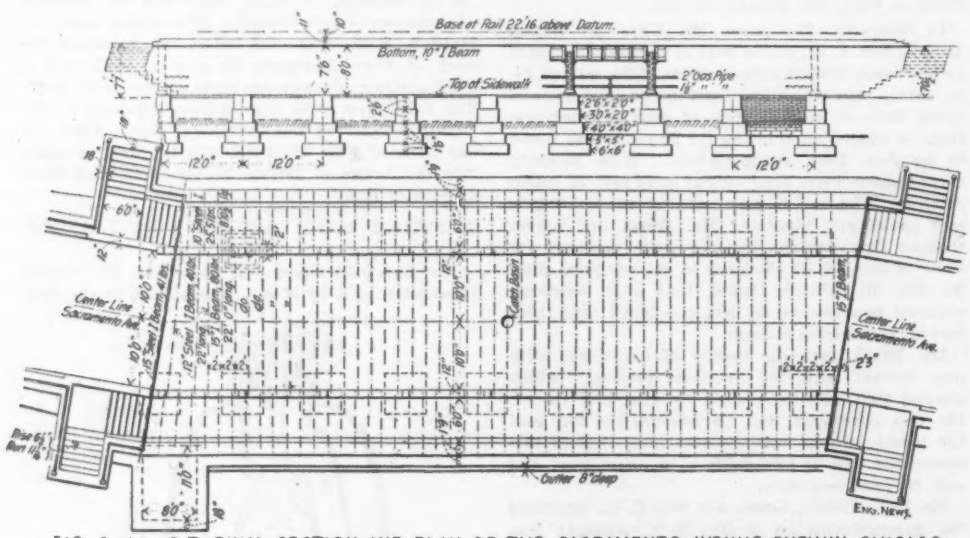


FIG. 2. LONGITUDINAL SECTION AND PLAN OF THE SACRAMENTO AVENUE SUBWAY, CHICAGO.

The columns supporting the flooring are made up of two channels latticed together, to which the girders are riveted by angles. Each is supported on a small masonry pier with the bottom course 6×6 ft. and stepped up to 2 ft. 6 ins. × 2 ft. at the top. These piers rest on clay and are calculated to bring a pressure of only 4,000 lbs. per sq. ft. or less on the soil. Between the piers is a masonry wall which serves to carry the sidewalk and cut off the roadway from it. These walls are continued at each end of the subway to form the retaining walls of the inclined approaches, as shown in Fig. 4.

In order to provide for the surface drainage a system of drains leading to two catch basins is provided. These catch basins are connected with a well from which the water is removed by a rotary pump with a capacity of 600 gallons per minute. This capacity allows for a rainfall of 4 ins. per hour on the area drained. The pumps were manufactured by the Morris Machine Works, of Baldwinsville, N. Y., and are operated by a pneumatic rotary moter, manufactured by the J. T. Case Engine Co., of New Britain, Conn. The compressed air for operating the motor is supplied by the Chicago & Northwestern Ry. Co. from the mains used for operating its pneumatic switches.

The entire structure was designed by Mr. W. L. Stebbings, Consulting Engineer, Chicago, Ill., and the work was carried out under his supervision. The contractors were Wilson & Jackson, of Chicago. The total cost of the work, including the right of way, was $50,000.

NOTES ON PILE FOUNDATIONS IN CHICAGO.

Owing to the unfavorable character of the soil underlying the city of Chicago, the question of foundations has always been one of supreme importance in that city. In general this soil consists of a layer of loam and sand overlaying a stratum of clay, which is sometimes hard and firm and sometimes soft and unstable. The practice which is, perhaps, most commonly followed in constructing the foundations for large buildings during the last few years has been to support each column by an independent foundation usually consisting of a footing course of concrete carrying two or more layers of steel rails or I-beams imbedded in concrete. A good exposition of the advantages of this type of foundations was given in our issue of Aug. 8, 1891. This system of independent foundations has not given entire satisfaction, however, and in some of the large buildings recently constructed pile foundations have been adopted. Although it would be incorrect to assume that they are superior to the independent foundations in all

cases or are destined to replace them in general practice, there seems to be a tendency toward their more common use. In our issue of July 6, 1893, a description was given of some tests of the pile foundations for the Chicago Public Library building, which showed very satisfactory results, and we abstract some further details of general interest regarding pile foundations in Chicago from a recent issue of the "Technograph."

Illinois Central R. R. Passenger Station.—In constructing the new station and office building for the Illinois Central R. R. Co. (Eng. News, April 28, 1892) the borings made showed from 10 ft. to 20 ft. of miscellaneous rubbish under which were irregular layers of stiff blue clay and quicksand, with rock at a depth of 60 ft. It was decided to use deep pile foundations, the piles being driven to a firm foundation and the tops sawed off below what was considered to be the water level of any possible system of drainage likely to be found necessary in the city.

The piles were arranged in groups or clusters under each column, about 1,700 being used in all.

FIG. 4. VIEW OF SUBWAY LOOKING DOWN THE APPROACH.

In the head house portion of the station consisting of three stories above the passenger tracks, these groups were of three sizes, viz., 8, 13 and 16 piles each. In the office portion, 9 stories high, the groups contained 20 to 42 piles each; while under the tower, 13 stories, one of the corner clusters has 73 piles. The piles in the groups were sometimes arranged on the square, lining both ways; but usually alternating in rows 18 ins. apart, making the distance between centers 25½ ins. This is as close as these piles could be driven, and sometimes in hard ground the position of the tops when cut off bore no resemblance to that in which the tips were started, while in a few clusters the piles did not vary more than 1 in. from where they were started.

The piles varied from 11 to 16 ins. in diameter at the butt end, and were from 40 to 60 ft. in length, averaging about 51 ft. It was specified that the piles should have a uniform taper, and no crooks, bends, knots, windshakes, etc.; but before driving care was taken to reject those having too much or not enough taper and also those having bends in two directions; 32% of the piles were black gum, 22% pine, 7% basswood, 21% oak, 15% hickory, with a few maple and elm. A cast iron cap was used in driving, but in spite of this 8% of the heads were crushed or split. The pine piles had the poorest driving record, the heads of 12½% of them being crushed and 5% broken; the gum came next, 7% being crushed and 0.6% broken; the oak had 5% crushed and 0.8% broken; the hickory had 3% crushed and none broken; 8% of the basswood piles had the heads crushed. In several of the oak piles, the sap wood was separated from the heart, the cores being driven through the shells. All of the piles were pointed to 4 ins. square.

The drivers used, three in number, were of the usual pattern of drop hammer, the weights of which were 2,800, 3,200 and 3,800 lbs., respectively. The driver having the heaviest hammer made the best record, viz., 26 piles driven home to a depth of at least 60 ft. below the surface. However there is some doubt as to whether this result was due to the greater weight of the hammer or to the greater ability of the crew of the driver.

The fall of the hammer at the last blow was usually 35 to 40 ft., though when driving close to a dwelling a fall of 25 ft. was used with about as good success. The penetration at the last blow averaged about 3 ins., though a large number went less than 1½ ins. The cap prevented much loss by brooming of the heads.

The distance to which the vibration due to driving was felt varied with the height of fall, the character of the soil, and the spacing of the piles. The vibration was easily felt at a distance of 400 ft., while the effect at 75 ft. was quite marked. However, in doing instrumental work it was sometimes found that the vibration within 25 ft. of the driver was less severe than at several times that distance.

One curious effect that the driving of piles had on adjacent objects was observed when a group of 16 piles was driven about 15 ft. from a group of eight which had been sawed off to a uniform height and had waling pieces drift-bolted on; the latter were raised 4 ins. next to the driver and 1 in. on the opposite side. Under similar conditions when 16 piles were driven about 15 ft. from a finished pier consisting of eight 47-ft. piles, 2½ ft. of grillage and concrete, and 12 ft. of stone masonry, the pier raised ⅝ in. on the side next to the driver, but on the farther side, 32 ins. distant, it remained at the original elevation. Two weeks later this pier was tested and the high side was found only ¼ in. too high, while the other side had not changed. Again, in a group of 72 piles a spike was placed in the head of the first pile driven, and elevations were taken daily; the first two days the pile sank ½ in., then rose steadily until 50 piles had been driven, when it was 3 ins. above the first height, the greatest rise in one day being ¾ in. This pile was 55 ft. long, of which 45 ft. was in the ground.

The piles were usually driven in groups till the tops of all were below the leads; then the driving was completed by means of a follower. Water was kept running around the pile at the surface when the pile was being driven, which seemed to help the driving to a considerable extent. After the piles had been driven, the tops were sawed off to a uniform height of 3 ft. below datum in order that all timber should be below low water. As this was from 10 to 14 ft. below the surface, it was necessary to excavate and sheathe the pits for the foundations and also to keep pumps running.

In excavating, the old pile trestlework upon which the Illinois Central formerly entered the city was uncovered in several places. It had been in the ground at least 21 years; but that portion which was below water was perfectly sound and was, perhaps, a trifle more dense than when first used, although the portion of the same piles above water had almost rotted away.

After the piles were cut off, the earth was excavated 18 ins. below their tops and rich Portland cement concrete was tamped in even with the tops of the piles. Oak caps 12×12 ins. were fastened on by a drift bolt in the center of each pile, and the space between the timbers was filled with concrete; on top of this came the masonry work. Under the headhouse, the masonry work on each pier consisted of 10 ft. 6 ins. of limestone and a plinth of Bedford limestone 2 ft. thick in two courses about 12 ins. each. All joints were about 1 in. thick. Under the office building there was 8 ft. 6 ins. of limestone, 2 ft. of sandstone and 2 ft. of granite, the granite being the plinth.

The stone was all set by a carriage running on tracks placed on either side of a row of piers; hooks were used to handle all the foundation stone. The top stone was brought to grade by laying a bed of mortar ¼ to ⅜ in. too thick and hammering the stone down to within 1-16 in. of the right height. The stones, even the heavy granite block 8 ft.×4 ft.×2 ft., were brought to center lines within ¼ in. without trouble.

Edison Light Co.'s Power-House.—In driving the piles for the foundations of the Edison Light Co.'s power-house, at the corner of Harrison St. and the Chicago River, in Chicago, a series of tests were made to determine the efficiency of the steam pile-driver, as compared with that of the ordinary drop hammer pile-driver. As will be seen, these tests developed some interesting information regarding the efficiency of pile foundations in Chicago soil.

Three piles were tested. The first was 50 ft. long and was driven with a drop hammer weighing 3,600 lbs. The length of the second pile is not given, but it was driven with a steam hammer weighing 8,100 lbs., the striking weight being 3,500 lbs., and the stroke 32 ins. The following were the results obtained:

	Pile No. 1, drop hammer.			Pile No. 2, steam hammer.	
Height of fall, ft.	No. of blows.	Penetration, ft.	ins.	No. of blows.	Penetration, ft.
6	10	8	0	15	5
6	10	6	0	19	5
10	10	6	6	28	3
15	4	2	3	31	2
15	10	4	0	19	2
20	10	3	5	20	1
20	10	1	9	25	1
30	10	1	7	20	1
				19	0.62

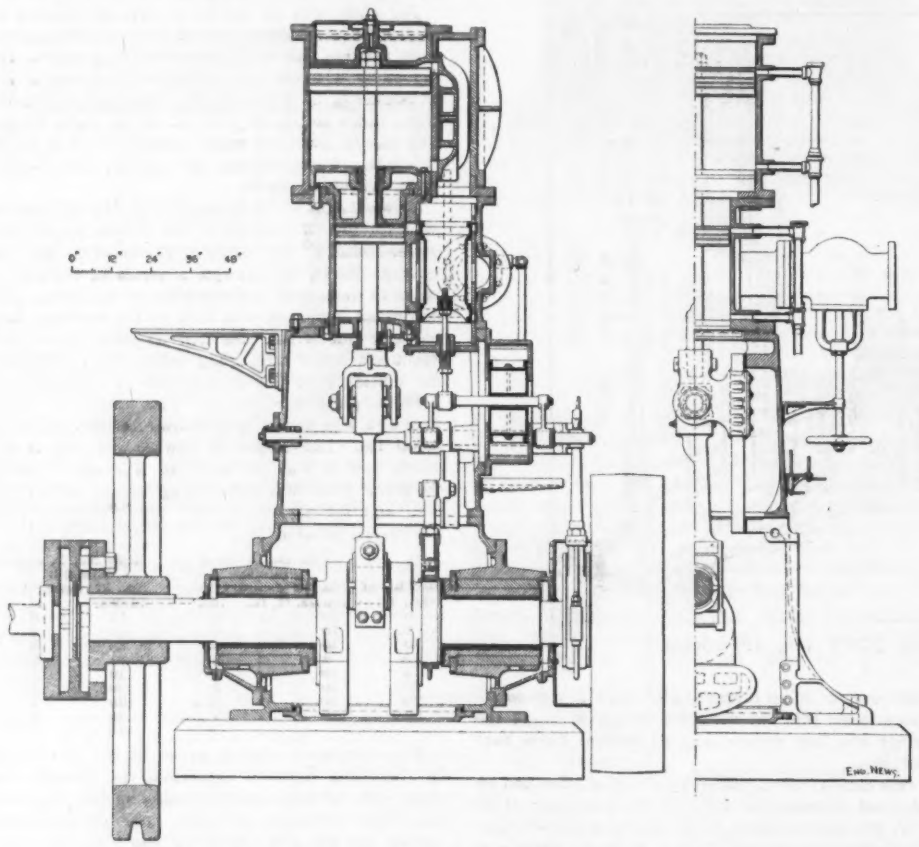
The calculated bearing power of the pile driven by the drop hammer according to Baker's formula, was 20 tons, and according to the Engineering News formula 25 tons. The corresponding values for the pile driven by the steam hammer were 10 tons and 6.7 tons, respectively.

The third pile was first submitted to 196 blows from the steam hammer which drove it 31½ ft., the penetration under the last 10 blows being 6 ins. After standing overnight the pile was given three blows with the drop hammer. Under the first blow with a drop of 2⅔ ft., the penetration was 0.4 in.; second blow, drop 15 ft., penetration 1.6 ins.; third blow, drop 20 ft., penetration, 1.7 ins. The last blow of the steam hammer moved this pile 0.6 in., while the same fall of a drop hammer having almost the same weight, gave a penetration of only 0.4 in. However, the last penetration was after the pile had stood overnight. After standing over winter it became necessary to remove these test piles. In attempting to lift them a 1⅛-in. chain was twice broken. Finally a vertical lifting strain of 40 tons was put upon each of the piles for a considerable time, with a sort of dancing motion, without starting any one of them. While trying to pull pile No. 1, a water-jet pipe was pushed down 35 ft. alongside of the pile, but did not seem to affect it in the least. Each was then driven about 4 ft. further, when they struck hard pan and could not be driven further with a 4,200 drop hammer. The foundation was completed by sawing off the piles and constructing a layer of concrete 2 ft. thick over their heads. The

foundations of the walls are separated from the engine foundations by a clear space of 12 ins., so that any settlement of one will not affect the other.

THE WESTINGHOUSE DOUBLE-ACTING COMPOUND ENGINE.

In our issue of Aug. 24, in connection with a description of the steam engine exhibits at the Columbian Exposition, we gave a perspective view of four of the Westinghouse 1,000-HP. compound engines, which form part of the power plant, each engine driving by direct connection a Westinghouse 15,000-light alternating dynamo. There are six of these engines in the power plant, all built from the same patterns. These engines were designed especially for the Exposition, and are the first of this pattern which the Westinghouse company has built. They were designed to meet the demand for a power unit of larger size than has heretofore been built by the Westinghouse company, one suitable for driving by direct connection the largest



THE WESTINGHOUSE DOUBLE-ACTING COMPOUND ENGINE.

alternating dynamos which the Westinghouse Electric Co. manufactures.

We show herewith sectional views of this engine. As will be seen, the engine is double-acting instead of single-acting, like the familiar styles of Westinghouse engines. The low-pressure cylinder is on top of the high-pressure cylinder, and the two cylinders have a common head between them which can be removed through the low-pressure cylinder for access to the high-pressure cylinder and piston without disturbing the alinement of either cylinder. The stuffing box in this head has the gland sunk flush with the level of the head.

The ports of the high-pressure cylinder are governed by a piston valve, and those of the low-pressure cylinder by a balanced slide valve. The balancing is effected in an unusual way. Instead of taking the pressure off the back of the valve, as is ordinarily done, steam of boiler pressure is introduced underneath the middle of the slide valve, and though the area is much smaller than the area of the top of the valve, the fact that the steam is of higher pressure relieves the valve seat of a good part of its load.

The low-pressure valve is driven by a fixed eccentric mounted inside the main bearing next to the crank and thus has a fixed cut-off. The piston valve of the high-pressure cylinder is driven by a shifting eccentric outside of the bearing controlled by a shaft governor. Thus the cut-off is regulated on the high-pressure cylinder only. The total weight of the piston valve and its connections carried by the shifting eccentric is about 1,000 lbs. With the engine making its normal speed of 200 revolutions per minute the inertia of this mass brings a heavy load upon the eccentric. To relieve this load, what the designer calls an inertia balance has been added to the valve gear. This consists of a 12-in. cylinder containing a long piston. When the engine is running the ports entering the ends of this cylinder are closed and the motion of the piston in either direction from the center is thus opposed by an air cushion. This piston is connected to and moves with the valves, and the air pocketed behind it becomes in effect a spring which absorbs the inertia of the valves and their connections on the last half of the stroke and stores it up to give them motion in the contrary direction on the first half of the stroke, thus greatly relieving the eccentric of its load.

This mechanism is also utilized for starting the engine. The valve gear of the high-pressure cylinder is so arranged that it can be disconnected from the eccentric, and the valve is then moved by turning live steam above and below the inertia balance piston until the engine is in motion, when the connection between the eccentric and the high-pressure valve gear is made.

The crank, connecting rod and the low-pressure valve gear are inclosed in the engine case and the lower part of the case is filled with oil, so that the same thorough and constant lubrication is secured to all the principal moving parts that is had in the older styles of Westinghouse engine. At the outer end of each main bearing is a chamber in which oil coming through the bearing collects and flows by gravity to the reservoir at the bottom. The main parts inside requiring lubrication carry cups which catch the splashing oil. With this method of lubrication the oil is used with greatest economy and with the least expense in application, and one charge can, by filtering, be used over and over again. The moving parts of the high-pressure valve system are outside the frame and so are lubricated from reservoirs with pipe connections.

Taking up the details of construction, the pistons are of cast iron, packed with spring rings; the piston rod, connecting rod and main shaft are forged steel; the crosshead and crank are cast steel. The two cranks with the crankpin are cast in one piece, which is keyed onto the two parts of the main shaft. The counterbalance weights are of cast iron, bolted onto the rear side of the cranks. The crosshead and guide are of the Laird pattern, which has been so much used in locomotive practice. The connecting rod has a solid end at the top, and on the crankpin end the strap is forged as part of the rod, and the filler piece back of the brasses is held by two bolts.

The eccentric straps are each 5 ins. in width The ample area of the main bearings is a noticeable feature. They are 14 ins. in diameter and 30 ins. long. All the bearings on the main shaft are babbited. The connection between the engine shaft and the dynamo shaft is made by a flexible drag-link coupling which allows difference in alinement of the two, liable to occur through inaccuracy in the erection or uneven settling of the foundations.

The engine has been designed to secure maximum power in a minimum space. It occupies a floor space of 11×15 ft. and stands 17 ft. 6 ins. high above the floor. This is 6 HP. per sq. ft. of floor space and ⅓ HP. per cu. ft. of total space occupied. The engine weighs 65 tons. The solid rim flywheel weighs 12 tons, and the flywheel carrying the shaft governor weighs 7 tons.

We are indebted to Mr. F. M. Rites, M. Am. Soc. M. E., the designer of the engine, for the drawings and the information from which our illustrations and description are prepared.

TEST OF A WORTHINGTON TRIPLE EXPANSION PUMPING ENGINE AT THE CONCORD (N. H.) WATER-WORKS.

A 2,000,000-gallon Worthington triple expansion pumping engine, with surface condenser, for high service duty at the Concord (N. H.) Water-Works was tested on July 5. The contract required that the above capacity be attained with a piston speed of not over 125 ft. per minute, and with the pump working against a total head of 83 lbs. and an effective steam pressure at the engine of 100 lbs. The duty to be secured was the raising of 700,000 gallons of water 190 ft. with a coal consumption of 15,000 lbs., equivalent to a duty of 73,900,000 ft.-lbs. per 100 lbs. of coal. The length of the test was eight hours. Mr. V. C. Hastings is superintendent of the Concord water-works, and we are indebted to him for the information given.

The engine is duplex, with three steam cylinders and water cylinder on each side. The diameters are 9 ins., 14 ins. and 22 ins., with 12-in. water cylinder and 18-in. stroke.

The chief conditions and results of the test were as follows:

Average steam pressure at boiler....	97.5 lbs.
" " " " engine ..	95. lbs.
" vacuum..	26.5 ins.
" length of stroke.....18.6 ins.	= 1.55 ft.
Total head.....87.1 lbs.	= 201 ft.
Total piston speed per minute of each plunger	138.88 ft.
Total gallons pumped	771,134
Rate pumping for 24 hours.....	2,313,402
Per cent. excess above contract capacity	15.67
Water fed to boiler and evaporated..	16,760 gallons.
Average temperature of feed water.	205°
Total coal fired.....	1,581 lbs.
Work done, total, 771,134 gallons pumped against a head of 201 ft. with 1,581 lbs. of coal fired. Equivalent gallons of water pumped 190 ft. with 1,500 lbs. of coal.....	773,983
Per cent. above guaranty.....	10.57
Duty on basis of 100 lbs. of coal....	81,686,871 ft.-lbs.
Duty on basis of 1,000 lbs. steam....	77,056,655 ft.-lbs.
Lbs. of water evaporated per lb. of coal, actual.....	10.6 lbs.
Equivalent evaporation from and at 212°	11.1 lbs.
Lbs. of coal per 1,000,000 gallons...	1.94
Gallons raised 190 ft. per lb. of coal.	515.9

During the test the manufacturers were represented by E. L. Maltby.

PERSONALS.

Mr. John W. Gray has been appointed City Engineer of Oakland, Cal., to succeed Mr. T. W. Morgan.

Mr. H. M. Herbert, of the firm of Focht & Herbert, has been appointed Borough Engineer of Bound Brook, N. J.

Mr. Alexander K. Rider, the inventor of the hot air engine which bears his name, died at Walden, N. Y., Sept. 14.

Mr. J. D. Farrell has been appointed Assistant General Superintendent of the Western Division of the Great Northern Ry., with headquarters at Spokane.

Mr. Arendt Angstrom has resigned his position as Naval Architect of the Cleveland Shipbuilding Co. to become Manager of the Doty Engine Works, at Toronto.

Mr. Theodore Paschke, who has been for nine years Chief Engineer of the Department of Public Works, of Guatemala, has resigned, and will locate in New York city.

Mr. Chas. Neilson, formerly General Superintendent of the Cincinnati, Hamilton & Dayton R. R., has been appointed Assistant General Superintendent of the Railway Mail Service.

Mr. Henry S. Drinker, General Solicitor of the Lehigh Valley R. R., and well known to engineers as the author of "Tunneling," has been elected a director of the Lehigh Valley R. R. Co.

Mr. J. E. Rose has been appointed Superintendent of the Arkansas division of the St. Louis, Iron Mountain & Southern Ry. to succeed Mr. W. T. Kelly, and Mr. W. J. McKee has been appointed Superintendent of the Central Division of the same road.

Mr. Alex. Mitchell, Superintendent of Motive Power of the Lehigh Valley R. R., was slightly injured in a head collision on that road near Fairview, Pa., Sept. 19. The collision was due to an engineer's disobeying orders and leaving the siding before the other train had passed.

Col. Robert A. Young, a civil engineer, died at his home in Brooklyn on Sept. 14, aged about 58 years. Colonel Young was born in Camden, S. C., served in the Confederate army, and at the close of the Civil War came north. He laid out Jerome Park and was engaged in general engineering practice.

Mr. Charles R. Johnson, President of the Johnson Railroad Signal Co., of Rahway, N. J., died on Sept. 11 at Saranac Lake, N. Y., at the age of 43. Mr. Johnson was a native of England, and was for some years superintendent for Saxby & Farmer, the famous English firm of signal engineers. He came to the United States in 1881, and in 1886 became General Manager of the Union Switch & Signal Co. In 1888 he established the Johnson Railroad Signal Co., and has devoted his energies since that time to building up its business.

Mr. Frederick L. Ames, Vice-President of the Old Colony R. R. Co., and a director in 40 railway corporations, died on Sept. 13, at the age of 58. He was a son of Oliver Ames and inherited his father's great business and executive ability. The early years of his business life were spent in the great Ames works at North Easton, Mass., but in his later years his surplus income was chiefly invested in railways, and most of his time was devoted to these interests. He was probably the largest owner of Union Pacific securities and had long been a member of its board of directors. His entire fortune is estimated at from $25,000,000 to $35,000,000.

NEW PUBLICATIONS.

THE RENO UNDERGROUND RAPID TRANSIT SYSTEM. A Description of an Underground System for Rapid Transit. J. W. Reno. 8vo, pamph.; pp. 16.

This pamphlet contains illustrations and a description of the system for underground railways invented by Mr. J. W. Reno, of New York city, as applied to underground rapid transit in New York. We have already described and illustrated the system in our issue of Feb. 27 and April 2 and 21, 1892.

DAMS AND RESERVOIRS OF RHODE ISLAND. Report of Commissioner L. M. E. Stone for 1892. 8vo; pp. 63; 22 plates.

Nearly 450 dams have been reported upon by Mr. Stone since his appointment, some ten years ago, and many have been illustrated in the annual reports. Ten dams and mill privileges are described in the present report.

THE STIRLING WATER TUBE BOILER. Chicago: The Stirling Co. 8vo, leatherette, pp. 80.

The Stirling is one of the newer types of water tube boiler, and it has already won for itself a wide popularity. The chief advantages claimed for it are that the tubes are self-cleaning, that interior circulation is superior, and that the details of construction make it safer and more durable than other types.

In the back part of the book is found a number of tables and considerable miscellaneous information relating to steam engineering. We notice especially a table computed by Mr. Fred A. Scheffler, M. Am. Soc. M. E., showing the mean effective pressure in the cylinder for various initial pressures and points of cut-off, computed with the proper allowance for exhaust opening and compression for each point of cut-off.

THE ENGINEERING SOCIETY ANNUAL. Vol. 1. Published by the Engineering Society of the University of Georgia. O. H. Sheffield, C. E., Editor and Manager; E. B. Eppes and R. J. Gantt, associates. Athens, Ga. 8vo; 88 pp.

According to the roll of active members this new engineering society numbers 28, including in this four members of the faculty, of which the editor in chief is one. For the present we only give a list of the papers presented, as follows: "Trigonometrical Surveys," M. C. Kollock; "Hydraulic Excavation," B. M. Hall; "Athens (Ga.) Water Supply," J. W. Barnett; "Georgia Marble," S. Lawrence; "The Engineering Department of the University; Damage from Back Water on Small Streams," C. M. Strahan; "Maintenance of Track," E. B. Eppes; "Artesian Wells," G. W. Beckett; "Levees," P. J. Shearouse; "Bridge Pier Foundations," R. J. Gantt; "The Forestry Question," R. B. Nally; "The Conversion of Heat into Energy," L. Lyndon; "The Civil Engineer in His Relation to Road Improvement," O. H. Sheffield; Graduates of the Engineering School.

THE RAILROAD QUESTION. A Historical and Practical Treatise on Railroads and Remedies for their Abuses. By William Larrabee, ex-Governor of Iowa. Chicago: The Schulte Publishing Co. 12mo; cloth; pp. 488; $1.50.

The author of this volume being a western man and formerly the Governor of a Western state where legislation affecting railways has been especially active, doubtless reflects with considerable accuracy the opinions of western people on questions of railway management and legislation. For this reason the book is well worth reading. Most of the arguments advanced are in favor of a more strict regulation of railway operations by the government, and have often been made before. In most respects they are sound and accurate, although perhaps a little overdrawn; but in a few cases they show a lack of knowledge regarding fundamental principles which leads to fallacious and often absurd reasoning. Perhaps the most interesting chapters are the two in which the author reviews and criticises former publications on railway questions and the one in which he reviews the various remedies which have been from time to time advanced for railway abuses. The book is concisely and clearly written.

THE ORE DEPOSITS OF THE UNITED STATES. By James F. Kemp, Professor of Geology in the School of Mines, Columbia College. New York; The Scientific Publishing Co.; 8vo; cloth; illustrated; pp. 302; $4.

Although written primarily for the mining engineer and student, this book should prove a useful addition to the library of the civil and mechanical engineer as well. Aside from the reports of the Geological Survey and other public documents and reports, and the proceedings of technical societies, all of which is scattered through many volumes, there has been no work of recent date treating of the deposition and characteristics of the great ore beds of this country. The present volume thus occupies a useful place in recent technical literature.

The book is divided into two parts; the first treating of the geological origin and classification of ores, and the second giving a concise account of the metalliferous resources of the country. The general scope of the introductory chapters, or Part I., is pretty clearly indicated by the headings of the chapters. These are as follows: I., General Geological Facts and Principles; II., The Formation of Cavities in Rocks; III., The Minerals Important as Ores; IV., The Filling of Mineral Veins; V., Certain Structural Features of Mineral Veins; VI., The Classification of Ore Deposits: a Review and a Scheme Based on Origin. In the second part the ore deposits of each metal are discussed separately and about in the order of their economic importance, iron being first and mercury, nickel, cobalt, tin, etc., last. Where, however, two are characteristically associated, as in many deposits of lead and zinc, lead and silver, silver and gold, nickel and cobalt, the two are treated together. Wherever possible the endeavor has been made to pass from the well understood to the more difficult, as is most conspicuously done with iron. Its bog ore deposits are first treated, as the origin of these presents no difficulties, while the magnetic lenses are taken up last, for their method of formation is most obscure of all. The book is plentifully illustrated and contains as notes to the several chapters a very complete bibliography of the geology of metalliferous deposits.

SOCIETY PROCEEDINGS.

NEW ENGLAND WATER-WORKS ASSOCIATION.—The fall outing of the association was held Sept. 13, at Plymouth, Mass., where the various points of historical interest and the local water-works pumping station were visited.

CENTRAL RAILWAY CLUB.—The next meeting will be held on Sept. 27, at 10 a. m., at the Hotel Iroquois, Buffalo, N. Y. The subjects for discussion will be "Car Lubrication" and "Modern Practice of Testing and Inspection of Locomotive Boilers."

INTERNATIONAL ASSOCIATION OF RAILWAY SUPERINTENDENTS OF BRIDGES AND BUILDINGS.—The third annual convention will be held at the Continental Hotel, Philadelphia, Oct. 17, 18 and 19. Mr. S. F. Patterson, Concord, N. H., is Secretary.

NEW ENGLAND RAILROAD CLUB.—The annual excursion and dinner of the club occurred on Wednesday, Sept. 13. The members and their friends to the number of 100 took a steamer of the Boston & Portland Steamship Co.'s line to Plymouth. Dinner was served at the Samoset House.

ENGINEERS' CLUB OF KANSAS CITY.—At the meeting on Sept. 11 Mr. Wynkoop Kiersted read a paper on the "Water Supply of Cities," in which he discussed impure and inefficient supplies. Much of this trouble, especially in the southwest, arises from the rapid growth of works without proper attention to the engineering and sanitary problems involved. The intermittent filtration of water was described and the use of wells for a supply approved. It was urged that cities should make larger appropriations for their boards of health and place better men upon them.

AMERICAN SOCIETY OF RAILROAD SUPERINTENDENTS.—The twenty-third meeting will be held in Chicago at the Grand Pacific Hotel, Oct. 12 and 13. The official program includes reports from the standing committees on Roadway, Machinery, Transportation and Signaling and papers on "Telegraphy and Telephone Service as Related to the Operating Department of Railways," by H. F. Royce, of the Chicago, Rock Island & Pacific; "Signal Appliances," by W. L. Derr, of the New York, Lake Erie & Western; "The Hobbs Island Transfer," by G. D. Hicks, of the Nashville, Chattanooga & St. Louis; and "Certain Common Factors of Railway Accidents," by Secretary C. D. Hammond. Other topics for discussion are "Employees," "Freight Train Service" and "Reducng Operating Expenses."

AMERICAN STREET RAILWAY ASSOCIATION.—The twelfth annual meeting will be held at Milwaukee, Oct. 18, 19 and 20. A paper is to be read on "The Construction of Underground Feeders," and committee reports are expected on the following topics: "Lighting and Heating Street Railway Cars," "Can the T Rail Be Satisfactorily Used in Paved Streets," "Direct Driven Generators," "Power House Engines," "Standard Form for Street Railway Accounts," "Standards for Electric Street Railways," and "Storage Batteries in Connection with Central Stations for Utilizing Surplus Energy for Lighting or Power." An exposition of street railway supplies will be held in the Milwaukee Industrial Exposition Building, and supply men can install their exhibits as early as Oct. 9. Further information may be obtained from the Secretary, Mr. W. J. Richardson, Brooklyn, N. Y.

ROADMASTERS' ASSOCIATION OF AMERICA.—The eleventh annual convention was held at Chicago Sept. 12, 13 and 14. There was a large attendance, and 90 new members were elected. At the first meeting on Sept. 12, Mr. H. W. Reed (Savannah, Florida & Western R. R.), President, read an address, and an address of welcome was delivered by Mr. Carter H. Harrison, Mayor of Chicago. The secretary read his report, and some general business was transacted. At the afternoon session on this day the reading and discussion of the reports of committees was begun. We give the substance of the reports and discussions as follows:

Care of Right of Way and Fences.

Grass, weeds and brush on the right of way should be cut, and burned as soon as dry enough, the work to be done in the months that suit the latitude. No material, new or old, should be allowed to be scattered along the track or right of way, except such as is wanted for immediate use.

Board fence, to give best results, should be not less than 4 ft. 6 ins. high and built of 1 in. boards 6 ins. wide and 16 ft. long. Five boards, properly spaced, and put on so as to break joints, should be used, with posts not less than 6 ins. at small end, spaced 8 ft. apart, and set at least 2 ft. 6 ins. in the ground.

Barbed wire fence should be at least 4 ft. 6 ins. high and have six strands, with top board; cap board may also be used. Posts should be set as for board fence. Where fence ends, or is broken, a wooden brace should be placed against the last post, near the top, and securely fastened to one or more posts back.

Woven wire fence, which in recent years has been used a great deal, we consider a good and durable fence, and one that will prevent small stock from getting through. The ends should be properly braced the same as the barb wire fence. Farm gates should

be at least 15 ft. long, to admit farm machinery. All swing gates should open away from the track.

In the discussion upon this report some members considered that fence posts would last longer if set with the small end in the ground. There was also considerable discussion as to the necessity of top and cap boards on barbed wire fences. Mr. W. W. Sharpe (Savannah, Florida & Western R. R.) advocated the use of a top board 2 × 4 ins., with barbed wire fence, as it saves one wire and keeps posts properly spaced, besides enabling animals to more easily see and avoid the fence. Mr. C. E. Jones (Chicago, Burlington & Quincy R. R.) thought no strand wire fence would turn hogs, though a woven wire fence might do so. He uses a bottom wire, two boards, and three or four top wires, according to the kind of stock. He also uses a batten at the middle of each panel of fence.

Brotherhood of Section Foremen.

The committee advised that the Association should not indorse or recognize the Brotherhodd, chiefly because it was a secret organization and was concerned in strikes. In the discussion, however, several members said that as labor organizations were bound to come it was best to meet them on friendly terms. A resolution was finally adopted to the effect that the Association is not sufficiently well informed as to the object of the Brotherhood to warrant its members in recommending foremen to join said Brotherhood; but that the members recognize the importance of doing all that can consistently be done to advance the intereats of the foremen employed by them, although the Association is unalterably opposed to any organization favoring strikes.

Track Appliances at the Columbian Exposition.

This report contained nothing of special interest that has not already been published in the last two issues of this journal.

Economy in Trackwork.

Quoting from Charles Paine: "The absolute minimum of expenses would exist upon a road where the condition of the track should be perfect . . . . An ideal track such as this may not be altogether attainable, yet it should be continually approached with the knowledge that every departure from the ideal condition is a cause of expense."

Economy in maintenance should influence every move of the locating engineer. No one should be permitted to locate a railway unless possessed of a thorough knowledge of the principles of maintenance. All curves over 2° should have long transition curves at the ends. Due regard for the drainage of the track, as well as the ratio of cut to fill, should influence the laying of the grade line on the profile. Avoid grade summits in the center of cuts. Such places are difficult to drain.

The quantity of ballast necessary on a given road will vary inversely as the quality of the track drainage. The depth of ballast under the ties should not be less than 6 ins. The distance between ties should be about the width of a tie, so that the rail will be supported over about 50% of its length.. The expense of putting a tie in the track is from 10 to 50% of its first cost; hence the economy in using those ties that will last the longest. Tie renewals cost nearly twice as much as rail renewals. Ties taken from the track should never be burned or removed from the right of way without rigid inspection by some officer thoroughly familiar with the use of ties, and the amount of work to be safely gotten out of them.

Rails should weigh 60 lbs. per yd. for engines weighing 40 tons or less, plus 1 lb. per yd. for each ton of increase in the weight of the engines. This Association should co-operate heartily with the American Society of Civil Engineers in its efforts to secure and introduce standard sections for each weight of rail.

We should employ better rail fastenings. The simple track spike does not enable us to get the full life out of good ties under heavy traffic. This committee deems it advisable that this Association appoint committees on the subject of tie plates and rail braces. The use of four to nine braces per rail on the outside and inside of sharp curves placed opposite each other will be found to reduce the cost of maintenance from 5 to 15%.

The perfect joint fastening cannot be made as cheaply as the common angle bar, and will only be forthcoming when our companies are willing to pay for it. The use of a good nutlock is strongly recommended. Selected ties should be used for the joints and should be tamped very hard.

Everything should be bought under rigid specifications and inspection, especially ties, rails, spikes, splices and bolts. The general practice of working "so many men to the section" without due regard to the relative condition of the sections is not economy. The maximum benefit to be derived from a given yearly expenditure will be secured by placing the entire amount at the disposal of the maintenance department at the beginning of each year. The head of the department will then subdivide this amount among his divisions as their needs require. If the appropriation has been correctly subdivided, the relative competency of those interested will be shown by the condition of their respective divisions or sections at the end of the year. The appropriation for betterments or construction should be separate from that for maintenance. When force must be reduced, it should be done gradually, so that all work under way can be safely closed up.

About once each year the track must be surfaced, lined and gaged. This work can be done with most economy out of a force working toward section headquarters. In this general surfacing the track should be raised just enough for secure tamping. This will average ½ to ¾ in. on ordinary ballast and about 1 in. on mud and sand. The greatest care will be required to keep the section men from raising the track too high. The best line and surface will be secured by having grade and center stakes set every three or four years. On sharp curves the center stakes should be tested once each year.

The work of the section men should be reduced to a routine. Nothing outside of their regular work should be required of them without the authority of the roadmaster. The dispatcher, agents, bridgemen and others should not give orders direct to the foremen except in cases of emergency. Extra work should be done by extra foremen and gangs expert in the particular work assigned them. A system of rewards either as premiums or as increase of pay to older and better foremen could be employed to great advantage. All such rewards should be given on the principle that the greatest benefit shall go to him who secures the greatest results per dollar of expenditure.

All tools, switches, etc., on a given system should be of standard design. It would be well if committees of this Association could be formed to bring out standard designs for all tools, etc., in our department. Purchase only first-class tools. They cost but little more than inferior ones. Keep a close check on all tools, supplies and material issued. Do not keep more tools or supplies on the sections than are needed. At division headquarters should be kept those special tools of which only a few are required. All tools with parts subject to wear should be bought under a guaranty that the wearing parts shall be interchangeable.

There was considerable discussion as to the spacing of ties, some members favoring a specified number of ties per rail, others a specified spacing c. to c. of ties, and still others a specified spacing in the clear, without regard to number or size of ties. A clear spacing of 10 ins. was considered necessary for shovel tamping with mud or gravel ballast. Reference was made to the wide spacing of steel ties on the New York Central R. R., 36 ins. c. to c. and 18 ins. at joints (rails laid to break joint), but although some members advocated a closer spacing of the joint ties than for intermediate ties, no action on this point was taken.

In its report as presented, the committee suggested that the joint ties might be made 6 to 12 ins. longer than the others, but the Association voted to strike this out. Such an arrangement would be unsightly and difficult to lay and maintain. In switch and frog work the committee recommended that general overhauling should be done by an extra gang, but the Association struck this out, as many members considered that their foremen should be able to do such work with a little extra assistance. Mr. Ramsey (Ohio Southern R. R.) said that on his road the change from stub to split switches had been done satisfactorily by the section foremen, working under the supervisor.

The matters of better rates of pay for foremen, and requiring applications for work by the section men to be made to the roadmaster or the section foreman, were also touched upon in the discussion.

Terminals.

The report of the committee on this subject recommended the use of gravity yards at division points and terminals wherever the topography permitted their being laid out, and stated that in a well designed gravity yard one engine and crew would do the work that in a level yard would require four or five engines. Poling was also recommended in preference to the use of shifting engines in the ordinary manner wherever the conditions were favorable. Concerning the layout of tracks in freight warehouses on a water front the committee said:

> Where piers and warehouses are built with a dock on each side, from one to three tracks down center of pier, with trucking space on outside, between tracks and edge of pier, are needed. Where warehouses are parallel with wharf front, space can be economized by having tracks enter the building at the side, and run at right angles therewith, or nearly so, and about half way across width of building. This method of layout will give more car room or rather more loading room than where track is parallel with building. This is especially the case where tracks are in pairs, say 12-ft. centers, with trucking space of 15 to 20 ft. between pairs, putting in as many sets of tracks as are needed. Ends of tracks should be within reasonable distance of wharf front to save as much as possible in the work of trucking, a very considerable item of cost in handling freight.

The report was adopted without discussion.

Subdrainage.

The report of this committee strongly recommended the use of subdrains wherever track gives trouble by heaving. In cuts such drains should be put in on both sides of the track, and they are frequently needed in fills on sidehills. Tile makes the best subdrain and also the cheapest. It gives a smooth surface for the flow of water. The tile should be not less than 5 ins. in any case, and large enough to take off all water freely, as the cost of laying is but little difference between a 5-in. and a 10-in. tile. Great care should be taken to lay it properly, getting tight joints and uniform grade with all the fall the outlet will allow, the grade to be not less than 3 ins. per 100 ft. in any case. Cover with slough grass, if possible; although hay or straw is better than nothing; then fill the ditch with cinders, gravel or other porous material if any can be had. Otherwise use stiff joint clay, but never cover with sand or loam. In laying in quicksand or mud it may be necessary to use a plank bottom or trough, covering as fast as laid to prevent displacement. The subdrains should be laid deep enough to be below frost; 2½ ft. below the bottom of the surface ditch is sufficient. At other points it should be laid at a greater depth, as freezing will destroy the tile. The outlet of all tile should be looked after and kept free, especially in winter, as springs may keep water running in cold weather. Some loose stone should be laid up around the ends, to keep out small animals. A wire netting answers for this admirably. Both ends of the tile should be kept open and free to allow circulation of air through the tile. The estimated cost for laying tile will vary from 25 cts. to 50 cts. per rod, according to material, or even more in quicksand cuts.

In the discussion on this report some members favored the use of glazed tile with open joints, but the majority preferred ordinary porous tile.

Track Joints.

The angle bar for years has been and still is the almost universal joint used upon American railways. It has been rolled in sections of almost endless variety of form and proportion, few of which, however, have demonstrated any appreciable advantage over those of the simplest pattern, the end sought in the improved forms having been maximum bearing surface consistent with a proper elastic fit and the limited conditions of space. Angle bars have been generally in lengths of 24, 30, 38 and 48 ins. They have been applied after various methods known as the "single tie supported joint," "the two-tie suspended joint" and the "three-tie supported joint," each and all of which have had their advocates.

Much difference of opinion has existed, and continues to exist, as to the advantage of lengthening the angle bar without altering its section. There is no doubt that some advantage has been gained by lengthening the bar, even where the section remained unchanged, but it is not thought that it has been so great as some claim for it—observation and experience tending to show that, generally, where long angle bar joints have been used they were put in with new and larger rail and under bettered conditions, such as are not without influence in creating the impression that the new and longer joint is superior to the old and shorter.

A very large proportion of the angle bars which break show a vertical fracture almost immediately at the joint, beginning at the upper edge of the perpendicular section and, extending downward. It is evident that this breakage is not caused by the downward pressure of the load when directly over the joint, but by the strain of the load immediately before and after passing the joint. Joints are often tamped harder than the adjacent quarters, and under such conditions stand high while the rail in the direction of the quarters is depressed. By stiffening the rail to a greater distance, the long bar undoubtedly does overcome this tendency to fracture to some extent; but the fact that it does break in the same place and manner calls attention to the weakness in the angle bar joint and the necessity of sub-strengthening it, not only to give increased strength to withstand the vertical stress of the load bearing directly upon it, but to give added strength in the direction of overcoming the counterstrain above referred to, due to high joints or low quarters.

Another very serious objection to this angle bar joint is the method of applying the support exclusively to the under side of the head of the rail, thus losing the benefit of the base and, to a large extent, of the truss depth of the web of the rail itself; besides transferring the line of strain to a point in the rail at the joint differing from that to which it is applied throughout its length.

In this connection it is well to call attention to the fact that the failure of the angle bar to give the full measure of service consistent with its present form is often to be found in causes disconnected with the bar itself. The bars should in the first place be of sections which, when fitted to the rail, will stand clear of the web and give the maximum of supporting

surface between the base and the ball of the rail. They should be punched in pairs; that is, one bar should be punched with oval holes to accommodate the oblong shank of the bolt, and the other with round holes to fit snugly around the body of the bolt near the thread, so that the nut or lock may have a good, firm base to seat upon; this, in combination with a bolt of good quality formed so as to require a slight blow of the hammer to drive the shoulder into the bar to the head, will give results far beyond those ordinarily obtained from the angle bar joint where such matters are neglected.

Having called attention to the defects of the angle bar joint, it is well to exhibit its merits. Nothing has so far been generally used which will keep track in as good line, or which could be applied so easily. These features, together with the cheapness in first cost, have enabled the angle bar to enjoy almost an exclusive monopoly for 20 years. It is recommended that these advantages be retained as far as possible in all improved forms of joint which may be adopted. Improvements should contemplate the adding to the present angle bar of features calculated to improve its efficiency and overcome its defects, rather than departures which tend to eliminate those features of established merit, and involve a complete change in the conditions of application and maintenance. It is probable that a joint could be devised which, while remedying the deficiencies, would retain the advantage of easy application possessed by the angle bar.

It is also the opinion of your committee that the joints should be relieved of the strain to which it has heretofore been subjected, in constituting the sole provision against creeping of rail, as it would seem that the proper maintenance of line and surface is about as much as can reasonably be expected of it; and, besides, the creeping of rail could be much better provided against by clamping the rail at quarters, so that the pull would be upon both ends of the same tie and not upon one end of two or three ties, as is the case when track is laid with "broken joints."

Commenting upon the subject of "track joints," the Engineering News, Dec. 28, 1889, says very forcibly that, "the underlying difficulty of the joint question seems to be that there has been too much effort to keep down the cost and too little effort to keep up the quality." This is undoubtedly the key note of the situation, and the improved joint must be obtained through an "effort to keep up the quality" of economy, not so much in the cost of the joint itself as in the net result of the year's expense account for maintenance.

The following joints have been submitted to your committee for tests and investigation during the past year: The Long truss, the Heath, the McConway & Torley, the Price, the Continuous, the Eno, and the Niles.

The Long truss joint (Eng. News, Dec. 28, 1889) has been proved to be of undoubted merit, after various tests in practical service for a number of years, and it is considered that it would justify a liberal trial.

The Heath joint (Eng. News, Sept. 19, 1891), in the form submitted, is an unattractive device and is not likely to commend itself unless somewhat altered and improved. If the angle forms were rolled so as to give the support usually obtained from the ordinary angle bar, and the base plate with depending fins retained substantially as it now is, it is thought that this joint would merit a fair trial. Formed as the vertical sections now are, it does not seem possible for the joint long to maintain an efficient support to the rail. It should be made longer and heavier, as well as of better form; at present it is difficult to apply and impossible to draw spikes from with the ordinary claw bar. The consensus of opinion is that this joint has done better than its appearances seemed at first to justify, and when intelligently designed and mechanically constructed it is recommended for further trial.

The McConway & Torley joint (Eng. News, April 21, 1888) can scarcely be considered as such, being rather an adjunct to a joint. It undoubtedly assists in developing the full strength of the angle bar, as well as in holding an even surface upon the rail at the joint. Where angle bars are used, especially upon light rail carrying heavy loads, it is believed that this would be found to be a valuable device.

The Price rail joint (Eng. News, Oct. 13, 1892) is made in a variety of forms, some of which are thought to be impracticable, and it is doubtful if any possess the necessary amount of metal to meet the requirements of joints under heavy traffic. It is but just, however, to say that the failure of the samples submitted properly to fit the rail has not made it possible to give this joint a fair trial. It is suggested that the manufacturer take up with some road the proper fitting of the joint to the rail section and the laying, under hard service, of at least one continuous mile.

The Continuous rail joint is simply an ordinary angle bar joint with the lateral plates rolled flat and bent squarely under the base of the rail. To the extent of the additional amount of metal, it is thought that this is an improvement upon the plain angle bar, beyond which it is doubtful if there is any mechanical merit. It is claimed by many to be a good joint and is, therefore, recommended as worthy of trial.

The Eno joint, as submitted, is an unmechanically constructed and impracticable device. The Niles joint, as submitted, by model, is an ingenious contrivance, the advantages of which are not evident to your committee.

A number of other joints have come to the attention of your committee which have not been submitted for test, but which appear to possess sufficient merit to recommend them for a test trial, namely: The M. W. Thompson joint* (said to be in use on the Chicago & Northwestern Ry.); the Richard Morgan joint (said to be in use on the Chicago, Burlington & Quincy R. R.); the C. S. Churchill joint (said to be in use on the Norfolk & Western R. R.); the F. A. Delano joint (said to be in use on the Chicago, Burlington & Quincy R. R.); the Clark-Fisher "triple" joint.

In conclusion, your committee would call the attention of manufacturers of improved joints to the absolute necessity of carefully and intelligently designing and fitting their joints to the rail section for which they are intended. No device, howsoever meritorious, will ever succeed in which these conditions are overlooked.

In discussing this report, Mr. R. G. Ward (So. Car. Ry.), the chairman of the committee, took strong ground against angle-bars longer than was necessary to cover the joint ties. Mr. J. W. Wright (Chicago & Northwestern), another member of the committee, considered the M. W. Thompson joint, the Blunt joint (Engineering News, Sept. 7) and the Long truss joint to be equal to the angle-bar joint in maintaining the alinement. There was considerable argument over the committee's remarks on individual joints, but it is difficult to see how the committee could have avoided them without shirking its duty, as the association has recommended joints for test. Mr. Sharpe thought these remarks were out of the province of the report, but several members thought the association ought to know what its committee said for and against certain joints. This view eventually prevailed, but, unfortunately, not until it had been voted to strike out the following remarks on the Long truss joint:

> The Long truss joint undoubtedly has merit. The channeled base plate should, however, be made long enough upon either side of the truss to fully cover the joint ties. The angle-bar should also be made sufficiently long to take in four bolts at least 5, 4 and 5 ins. between centers respectively; and it is thought that the joint thus made would be improved by shearing the angle-bars from near the truss bolts out to the ends, so that the bar beyond the truss bolts would be reduced to the form of a plain strap. This would permit the spiking of the base plate firmly to the tie, and leave the movement to take place between the rail and plate directly over the joint ties, instead of between the plate and tie, as would otherwise be the case. The necessity for raising the rail to apply this joint is an objectionable feature, but it is thought that if constructed with careful attention to improving details it would justify a liberal trial.

The discussion on the Heath joint brought out similar arguments, but it was pointed out that the criticism was by no means a condemnation, but gave advice to the manufacturer as to how to improve his joint to adapt it for practical service. The report was accepted and the committee was continued, with the request that it continue its investigations and report at the next convention.

At the meeting on Thursday morning, Sept. 14, it was voted to send three delegates to the meeting of the American Railway Superintendents' Association on Oct. 4, Mr. H. W. Reed, President of the Roadmaster's Association, to be chairman of the delegation. The paper on "New Signaling Appliances," which was on the program, had not been prepared, owing to some misunderstanding, and the next business was the reading of five papers presented in competition for the prize offered by the "Railway Age" for the best essays on "How to Maintain the Best Track at Least Cost." All of the papers dealt more or less with the unsystematic practice of railway managers in their provision for trackwork and improvements, and recommended a more intelligent practice in order to enable the men in charge of track to carry on maintenance systematically and economically, which they cannot do when constant changes are being made in the working force and in the provision of material. This view of the question was discussed in an article on "Railway Track and Train Service" in our issue of June 15, 1893. The first and second prizes were awarded respectively to Mr. W. W. Sharpe (Savannah, Florida & Western R. R.) and Mr. G. W. Merrill (Chicago, Milwaukee & St. Paul R. R.).

At the afternoon session the new constitution and by-laws were discussed section by section, and adopted as amended. It was voted to hold the next annual convention at New York, in 1894, and also that the association should be incorporated under the laws of some state. The election of officers for the ensuing year resulted as follows:

President: H. W. Reed: Savannah, Florida & Western R. R., Waycross, Ga. First Vice-President: C. E. Jones; Chicago, Burlington & Quincy R. R., Beardstown, Ill. Second Vice-President: I. O. Walker; Paducah, Tennessee & Alabama R. R., Paris, Tenn. Secretary and Treasurer: W. W. Sharpe; Savannah, Florida & Western R. R., Waycross, Ga. Retiring President: John Doyle; Detroit, Lansing & Northern R. R., Grand Rapids, Mich.

Executive Committee: W. H. Stearns, Chicago & Northwestern Ry., Oak Park, Ill. (four years). F. R. Doty, Illinois Central R. R., Amboy, Ill. (three years). E. P. Hawkins, Mobile & Ohio R. R., Artesia, Miss. (two years). G. W. Merrill, Chicago, Milwaukee & St. Paul R. R. (one year).

Exhibits.

The exhibits included the Page fence, by the Page Woven Wire Fence Co., of Adrian, Mich.; the Dunn switch, illustrated and described in our issue of Aug. 23, 1890; the Walton cattle guard, with a row of prongs rising in front of any animal stepping on the guard (Engineering News, Nov. 3, 1892), by the Walton Automatic Stock & Cattle Guard Co., of Fort Madison, Ia.; the steel tie of the Lancaster Steel Railway Tie & Fastening Co., of Brooklyn, N. Y.; and the McHugh rail joint, consisting of a base plate and splice bar in one piece, with a separate splice bar for the opposite side of the rail, locking itself when put in place, and holding the rail by two studs, all bolts being dispensed with.

*The above joints have been illustrated and described in previous numbers of Engineering News, as follows: Thompson, June 1, 1889; Morgan, July 13, 1889; Churchill, Dec. 8, 1892; Delano, Feb. 2, 1893; Fisher triple, Aug. 25, 1892.

COMING TECHNICAL MEETINGS.

NEW YORK RAILROAD CLUB.
Sept. 21. Secy., John A. Hill, Temple Court, N. Y.
ENGINEERS' CLUB OF CINCINNATI.
Sept. 21. Secy., J. F. Wilson, 24 W. 4th St.
SCANDINAVIAN ENGINEERING SOCIETY OF CHICAGO.
Sept. 21. Secy., Allen Strale, 100 Washington St.
SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.
Sept. 21. Secy., S. A. Charpiot, Macon, Ga.
CANADIAN SOCIETY OF CIVIL ENGINEERS.
Sept. 22. Secy., C. H. McLeod, Montreal, P. Q.
DENVER SOCIETY OF CIVIL ENGINEERS.
Sept. 26. Secy., F. E. King, Jacobson Block.
CENTRAL RAILWAY CLUB.
Sept. 27. Secy., S. W. Spear, Buffalo, N. Y.
CIVIL ENGINEERS' SOCIETY OF ST. PAUL.
Oct. 2. Secy., C. L. Annas, City Engineer's Office.
ENGINEERS' SOCIETY OF PHŒNIXVILLE.
Oct. 3. Secy., W. Halliburton.
WESTERN SOCIETY OF ENGINEERS.
Oct. 4. Secy., Jno. W. Weston, 51 Lakeside Bldg., Chicago.
ENGINEERS' CLUB OF ST. LOUIS.
Oct. 4. Secy., Arthur Thacher, Odd Fellows' Building.
AMERICAN SOCIETY OF CIVIL ENGINEERS.
Oct. 4. Secy., F. Collingwood, 127 East 23d St., New York.
AMERICAN SOCIETY OF RAILROAD SUPERINTENDENTS.
Oct. 4-5. Chicago, Grand Pac. Hotel. Secy., C. O. Hammond Boston.
ENGINEERS' CLUB OF MINNEAPOLIS.
Oct. 5. Secy., E. Nexsen, 504 Kasota Block.
ASSOCIATION OF CIVIL ENGINEERS OF DALLAS.
Oct. 6. Secy., E. K. Smoot, 805 Commerce St.
TECHNICAL SOCIETY OF THE PACIFIC COAST.
Oct. 6. Secy., O. Von Geldern, 719 Market St., San Francisco
ENGINEERS' CLUB OF PHILADELPHIA.
Oct. 7. Secy., L. F. Rondinella, 1122 Girard St.
ENGINEERS' CLUB OF KANSAS CITY.
Oct. 9. Secy., Waterman Stone, Baird Building.
WISCONSIN POLYTECHNIC SOCIETY.
Oct. 9. Secy., M. F. Schinke, City Hall.
CIVIL ENGINEERS' CLUB OF CLEVELAND.
Oct. 10. Secy., F. C. Osborn, Case Library Bldg.
NORTHWEST RAILROAD CLUB.
Oct. 10. Secy., W. D. Crosman. Ryan Hotel, St. Paul.
NORTHWESTERN SOCIETY OF ENGINEERS.
Oct. 10. Secy., D. W. McMorris, Burke Block, Seattle, Wash.
INTERNATIONAL IRRIGATION CONGRESS.
Oct. 10-14. Los Angeles, Cal. Arthur L. Thomas, Salt Lake City, Utah, Chairman National Executive Committee.
CIVIL ENGINEERS' ASSOCIATION OF KANSAS.
Oct. 11. Wichita, Kan.
NEW ENGLAND RAILROAD CLUB.
Oct. 11. Secy., F. M. Curtis, O. C. R. R., Boston.
ENGINEERING ASSOCIATION OF THE SOUTH.
Oct. 12. Secy., W. G. Kirkpatrick, Nashville, Tenn.
ENGINEERS' AND ARCHITECTS' CLUB OF LOUISVILLE.
Oct. 12. Secy., F. W. Mowbray, Norton Building.
AMERICAN SOCIETY OF RAILROAD SUPERINTENDENTS.
Oct. 12. Chicago, Ill. Secy., C. A. Hammond, 350 Atlantic Ave., Boston, Mass.
NORTHWESTERN TRACK AND BRIDGE ASSOCIATION.
Oct. 13. Secy., D. W. Meeker, St. Paul.
MONTANA SOCIETY OF CIVIL ENGINEERS.
Oct. 14. Secy., G. O. Foss, Helena.
WESTERN RAILWAY CLUB.
Oct. 17. Secy., Clement F. Street, Chicago.
COLUMBIAN ENGINEERING SOCIETY.
Oct. 17. Secy., F. W. Hart, Washington, D. C.
ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.
Oct. 17. Secy., R. H. Clark, Pittsburg.
INTERNATIONAL ASSOCIATION OF RAILWAY SUPERINTENDENTS OF BRIDGES AND BUILDINGS.
Oct. 17-19. Annual Convention at Continental Hotel, Philadelphia. Secy., S. F. Patterson, Concord, N. H.
BOSTON SOCIETY OF CIVIL ENGINEERS.
Oct. 18. Secy., S. E. Tinkham, 36 Broomfield St.
ASSOCIATION OF ENGINEERS OF VIRGINIA.
Oct. 18. Secy., L. V. Carmalt, Roanoke, Va.
AMERICAN STREET RAILWAY ASSOCIATION.
Oct 18-20. Annual Convention at Milwaukee. Secy., Wm. J. Richardson, Brooklyn, N. Y.
TACOMA SOCIETY OF ENGINEERS AND ARCHITECTS.
Oct. 20. 201 Washington Building.
SWEDISH ENGINEERS' CLUB.
Oct. 21. Secy., P. Valentine. At 221 Union St., Brooklyn, and 646 North 10th St., Philadelphia. At 190 La Salle St., Chicago. Secy., John Ericson.

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ADVERTISING RATES: 20 cents per line agate measure. Schedule sent on request. Changes of advertisements must be in hand on Monday afternoon; new advertisements, Tuesday afternoon; transient advertisements, not later than Wednesday noon. The last page: go to press early on Thursday. We shall be obliged if subscribers who fail to receive their papers promptly will notify us without delay.

The headquarters of Engineering News on the grounds of the World's Columbian Exposition are at Section K, Aisle 37, of Machinery Hall (central aisle, just west of the large water tank), and at Section U N, Posts 10 to 11 (office No. 9), of the Transportation Building Annex, at the west end of the Great Britain railway exhibit. For the convenience of subscribers and advertisers, it is announced that some member of the editorial staff of this journal may be found at the first-named office, in Machinery Hall, from 10 to 10:25 a. m., of each week day, and from 10:35 to 11 a. m. at the second-named office, in the Transportation Building; as also frequently at other times. Appointments may be made by calling at our downtown Chicago office in the Monadnock Building.

The Engineering headquarters, at Chicago, are at No. 10 Van Buren St., directly opposite the viaduct leading to the Illinois Central R. R. World's Fair trains, and to the steamboat pier, and but a stone's throw from it. The rooms are large and comfortable, and include reading, writing, smoking and other apartments. The rooms are to be kept open during the Fair by subscriptions of engineers, and all American and foreign engineers visiting Chicago are invited to register and make free use of the rooms during their stay, and to have their mail addressed there. An informal reception is held at these rooms every Monday evening from 8 to 10 p. m.

In our article on "Track Exhibits at the World's Columbian Exposition," on p. 186 of our issue of Sept. 7, the address of Messrs. J. H. Sternbergh & Son, makers of the Harvey grip thread bolt, was given as Pittsburg, Pa., by mistake. The correct address is Reading, Pa.

The trial of cases involving technical questions of considerable difficulty is made the subject of an editorial by "Industries and Iron." The five distinct modes of trial applicable to the determination of such questions in English courts are given as follows: Trial by judge sitting alone; trial by judge sitting with an expert assessor; trial by judge and special jury; trial by judge and common jury, and trial by a referee, either appointed by the judge or by consent of parties interested. Of these, as all men know, the very worst method is the trial by a common jury and several of the other methods are almost as bad. In our own practice, as in England, much of the testimony in a technical case is of a textbook character brought out by the counsel in the case with the one object of educating the judge in matters with which he is not supposed to be familiar. No matter how able or conscientious a judge may be, many cases must come before him so involved in technicalities that he cannot be trusted to take all the points himself, and the oral testimony under the conditions named is usually so voluminous and so padded with irrelevant matter that even full shorthand notes serve rather to embarass than to enlighten the interpreter of the law. It is for these reasons that our contemporary proposes that an expert should be commissioned to take part in the inquiry and make such notes for the benefit of the judge as his broader experience with the general subject would readily enable him to do without clogging his notes with the rubbish of the case. Our contemporary properly concludes by saying that a judicial system in which the judge cannot be expected to charge his functions satisfactorily stands condemned by that fact alone.

The suggestion made, while not new, seems a wise one and should work well in practice. Under the system which only uses experts called by the opposing parties there is too generally a conflict of authorities and a handling of facts from prejudiced standpoints that simply befog the ablest jurist and lead him, when possible, to toss the whole expert evidence to one side and decide the case upon its general merits. This is neither creditable to the profession involved nor is it satisfactory to the litigants, and such a decision is without its proper weight and authority with the public. A system which engages experts to testify in one direction only, and that direction fixed beforehand, is not conducive to honesty of expression or to the true relation of the points at issue, for, unfortunately, experts can always be found for both sides of a question, and one side must be wrong. It would seem, then, to be much better to place a case meriting this care either solely in the hands of an expert commission appointed by the court and ordered to report to that court upon the technical merits of the case or, as "Industries" recommends, to have an expert pilot for the presiding judge. Existing practice needs some material modification in this direction, and every new case brought up in this scientific and inventive age makes this need more apparent. The change would benefit all concerned; even the losing party in the contest would usually be better content if he knew that the decision was based upon full knowledge and appreciation of the vital points of the case, rather than upon the technical ignorance of the judge or superior smartness in his opponent's attorney and the witnesses secured by the opposition.

It is commencing to look as if the time was approaching when war would be made so horribly destructive of human life and material property that nations by common consent would disarm and settle their differences by arbitration and indemnities. It is the nature of man to battle for his supposed rights with all the weapons nature and science can provide for him, and this human nature has not yet changed sufficiently to permit a willing and speedy resort to intellectual as opposed to physical weapons of offense and defense. But science and mechanical skill are hastening the day; and self-interest, if not common sense and a sense of common justice, will some time inaugurate methods of settling national disputes more in accord with the intellectual as well as material advance of the last few decades. The appliances of war are constantly becoming more destructive and at the same time more complicated and unwieldy, and the ablest admiral of Nelson's time would neither know how to handle or to fight his ship were he to suddenly find himself in command of a modern man of war. Millions of treasure are locked up in these costly fighting machines and in the other millions of men set aside for fighting the prospective battles of Europe. And destructive as are the arms of the modern soldier, the end is evidently not yet. Within a month Dr. Gatling, by adding an electric motor to the feeding apparatus of his gun, is said to have increased its discharging capacity from 3,100 to 5,000 shots per minute. And now comes M. Turpin, the inventor of the mysterious and troublesome melinite, who claims that he has invented a gun to be used in connection with his explosive that four times in each 15 minutes will belch forth 25,000 projectiles and annihilate an army corps as by a gust of wind. The inventor, through the London "Telegraph," stoutly claims that his gun will do a hundred times more damage than the heaviest siege artillery, so that fortifications will be useless, and that ironclads will be simply obliterated. M. Turpin's statements must be taken with a grain of salt of greater or less dimensions; but if he or any other man can realize half of what he claims can now be accomplished, there will be an end to warfare among civilized nations. It will cost too much, and in this commercial era that consideration will win, though natural inclination points in some other direction.

In commenting on the Long Island R. R. collision in our issue of Sept. 7 we referred to the defective brake equipment of the train and the possibility that the quick-action brake might have prevented or greatly mitigated the accident. While the facts as reported by us were substantially correct, additional particulars which have since come to our knowledge make the case with reference to the brake equipment appear much more favorably for the company and its officials.

The company adopted the Westinghouse quick-action brake two years ago, and has been since that time removing the vacuum brake on its rolling stock as rapidly as possible. At present all but four of the Long Island cars proper are equipped with Westinghouse brakes, and the four which still have the vacuum brakes are running in service where a brake failure would be unimportant. The Rockaway Beach and Manhattan Beach cars still have vacuum brakes, but are to be fitted with Westinghouse brakes this winter.

With respect to the driver brakes on the ill-fated train, while it is true, as the engineman testified, that an order was in force forbidding the use of the driver brakes on the engine which was wrecked, that order was issued for special reasons, and the Superintendent of Motive Power, Mr. Samuel F. Prince, Jr., is a strong advocate of the use of the driver brake in combination with the train brake. The locomotives in service on the Rockaway Beach line this summer are new, heavy engines equipped with Westinghouse apparatus and driver brakes of the cam pattern. At the beginning of the season engineers were instructed to use their driver brake (air) as well as their train brake (vacuum) in making all stops; but a weakness developed in the studs supporting the driver brake gear, and as there was danger of the brake gear dropping down on the rail and causing derailment in case the stud should give way, engineers were instructed to cut out their driver brakes and use the air only on the tender. New material to replace the defective parts was at once ordered and was hurried forward as fast as possible, and one of the engines had been equipped with it on Aug. 26, when the collision occurred.

We make these corrections in justice to the Long Island R. R. Co. and its officers. The practice of reserving the driver brake for emergencies has been defended by high authorities; but experience has abundantly proved that the safety device which is never used save in an emergency will never be thought of when the emergency comes. We are glad to learn that the Long Island Co. is not among those that adhere to a mistaken notion as to the use of the driver brake.

Following close on our comments in last week's issue on the lesson of the recent railway collisions comes the news of another very serious collision which occurred on the night of Sept. 18 on the Cleveland, Cincinnati, Chicago & St. Louis, resulting in the death of 8 persons and the injury of 22. The accident was a rear collision. The second section of an express train crashed into the first section, which had lost time and was standing at a water tank. According to such reports as have reached us, it appears that the first section was standing on a straight track and the engineer and fireman of the second section claim that the rear brakeman did not go back and that they did not see the tail lights of the standing train until

they were close upon it. That trainmen are apt to use their own discretion, or rather indiscretion, about going back with a flag when a long tangent stretches away to the rear is well known; but the train crew of the first section unite in declaring that the brakeman went back. Even granting that the flag was not sent back, the engineer of the second section ought to have seen the tail lights on the train ahead in time to stop. The fireman is reported as saying that "when we approached Manteno, I saw the engineer step to the side of the cab and look out; the next minute we struck the car ahead of us." This also would indicate that the engineer was not keeping a proper lookout. Apparently the speed of the train was checked little if at all before the collision occurred, for the rear car of the standing train, an empty Pullman sleeper, was forced forward and badly telescoped the second sleeper, which was filled with people.

The flimsy nature of the safeguards provided against rear collisions by the time interval method of moving trains is again proved by this latest horror, if proof were needed. If a railway is too poor or too lethargic to adopt some form of blocking, it has no business to assume the risk of running passenger trains in sections in imitation of the roads using block signals. The added risk of running additional trains as extras is well known, but with a proper system in the train dispatcher's office, it seems safer to do this than to have passenger trains follow each other over the road with nothing but good luck and a brakeman's lantern to keep them apart.

BRAKES FOR ELECTRIC CARS.

We have several times referred to the need of better brakes on electric cars for the purpose of lessening to some extent the present seriously large number of accidents due to the running of such cars at considerable speeds in crowded streets. The course of events is proving very conclusively that better brakes are needed on many lines for the safety of the passengers quite as much as for the protection of other travel in the streets.

It is not sufficiently realized, we believe, by car builders or by street railway managers how vastly more important the brake gear is on an electric car than it is on a horse car, on account of the much steeper grades over which the electric car is likely to be run. It is a fact that no engineer would have dreamed a few years ago of laying out a railway line for anything but cable traction with such grades as are now operated over regularly by electric motors. The only limit recognized now is what the present powerful motors can haul up the hill without blowing a fuse or slipping the wheels.

On ordinary railways operated by locomotives, 4% is about the maximum grade that is ever used, although 8% and even 10% have been used on temporary mountain lines. Horse railways have been practically restricted in maximum grades to that up which a pair of horses with one or two helpers can haul a loaded car. The electric car, however, is confined within no such narrow limits. The engineer laying out an electric line nowadays puts it where the greatest traffic is to be had regardless of grades, unless something steeper than about 10% is encountered. This applies not only to the roads laid in city streets, but to those which follow along beside country roads, where a little grading would considerably improve the profile. But grading means an addition to the first cost of the line, and so we see electric roads going up hill and down dale, following all the surface undulations in a way which has never been attempted by railways of any other class.

Combined with these grades are curves as sharp as anything used on horse car lines, where a slow-up is essential to avoid derailment. These curves are not infrequently located at the foot of a grade and one sees the motormen approach them at high speed, and delay slowing down the car until the last moment; in fact, they are often obliged to do this in order to make their time.

It would be folly to say that it is bad engineering to locate roads in this way. There are many cases, perhaps, where better grades could be secured, but for the most part the road must go where it will best accommodate the traffic, and curves on a street railway must be sharp of necessity. It only remains, then, to make the operation of the road under these conditions as safe as possible, and the device of greatest importance to safe operation is the brake.

It is not generally understood except by engineers, and not always by them, how very rapidly the danger of runaways increases with the steepness of the grade. Let us take, for example, a total fall of 50 ft., which, if it were distributed over a length of a mile, would give a grade of slightly less than 1%. Suppose a car starts down such a grade at a speed of five miles per hour, and is allowed to run freely to its foot. The resistance due to the friction of the car, if we estimate it at 10 lbs. per ton, will be equivalent to a grade of ½%, tending to check the speed of the car, so the actual acceleration of the car will be that due to a grade of ½% only. Then, the speed of the car at the foot of the grade will equal that due to the vertical fall of ½ of 50 ft. plus the velocity head due to its initial speed of five miles per hour at the top of the grade, which is nearly 1 ft. The speed due to this total fall of 26 ft. will equal 27.1 miles per hour.* The average speed down the grade will be $(27.1+5)\div 2=16$ miles per hour, and, calling the total length of the grade one mile, we have 3¾ minutes consumed in the run down the grade.

Now, suppose the rate of grade to be 2%, the total vertical descent being the same as before. The distance to be run now will be only one-half mile, and, subtracting as before the grade of retardation due to the friction of the car, ½%, we have a 1½% grade as the net accelerating force. The speed at the foot of the grade will be 32.9 miles per hour, and the half mile will be passed over in 1 minute 35 seconds.

By similar computations it is readily shown that a total descent of 50 ft. on a 4% grade will give a final speed of 35.5 miles per hour, and the distance will be passed over in 42 seconds. On a 7% grade a car will run only 714 ft. to make a descent of 50 ft. It will reach the foot with a velocity of 36.5 miles per hour and will require only 24 seconds for its downward trip.

It will be seen from the above that if a car with a broken brake is running away, the final velocity attained will be about the same on a steep grade as on a moderate grade of 2% or so, the total vertical descent being supposed to be the same. The important difference between the moderate grade and the steep grade is the rate at which the car gains in velocity. On a moderate grade the motorman who finds his brake out of order has time to try the rear brake, to reverse the motor, or as a last resort to throw obstructions under the wheels and call to the passengers to jump from the car before its speed becomes dangerous. On a very steep grade, however, there is too little time to avert disaster. A few seconds' fouling of the brake rigging may be as fatal in its effects as if it were broken. The car gains speed so rapidly that an attempt to stop it by reversing the motor, as at present constructed, is well nigh certain to burn out a fuse wire or an armature and leave the motor useless. By the time that the motorman realizes that the car is beyond his control, it will have already attained such speed as to make a jump from it dangerous.

Another factor of great importance is the small holding power of brakeshoes at high speeds. Engineers accustomed to handling air-braked freight trains on steep mountain grades understand well that a train must not be permitted to attain too high a speed in the run down hill or it will be beyond control. If it once gets up to high speed, the coefficient of friction of the brakeshoes may become so low as to little more than balance in retarding effect the acceleration due to the grade. For example, suppose a 60,000-lb. car, weighing 30,000 lbs. light or 90,000 lbs. loaded. The brakeshoe pressure at 70% of the light weight would be 70% of 30,000 lbs. = 21,000 lbs.; and the retardation, assuming a coefficient of friction of ⅛ between the brakeshoe and the wheel, would be ⅛ of 21,000 lbs. = 2,625 lbs. The acceleration due to grade is 20 lbs. per ton multiplied by the rate per cent., so if we assume the car to be loaded to its full capacity and running down a 2% grade, the force tending to accelerate it is $20 \text{ lbs.} \times 2 \times 45 = 1{,}800$ lbs., thus leaving a net retarding force of only $2{,}625 - 1{,}800 = 825$ lbs., or 18.3 lbs. per ton.

*See table on p. 335, Wellington's "Economic Theory of Railway Location."

Of course, this refers to freight cars, but the same law of the reduction of the coefficient of friction with increase of speed applies to street car service. The difference in weight of the empty and loaded car, however, is small compared with freight cars, though it is large compared with standard passenger car service.

At present nearly all electric cars in use have brakes applied by hand, and the motorman, if properly instructed, can vary the braking force according to the load in the car, the speed at which he is running and the condition of the rail, so as to get the maximum braking force without slipping the wheels. It is probable that air-brakes of some sort will before long displace hand brakes on electric cars, and it is a point worth noting that in their design provision should be made for varying the braking force to suit the conditions. The superiority of the air-brake to the hand brake arises from the fact that it can be applied practically instantaneously, whereas with the hand brake one to two seconds is required to take up the slack in the brake rigging and apply the brake with full force. With trailing cars there is, of course, a further advantage from the use of the air-brake, as the motorman at the head can apply brakes on the whole train as quickly as on one car. We discussed this matter at length in our issue of July 11, 1891.

But to handle electric cars safely on steep grades, quickness of application is not after all so important as certainty of application with full power. All parts of the brake rigging should be designed with so large a factor of safety as to make breakage impossible, and in designing the rods, levers, etc., every possible chance of fouling should be watched for and guarded against. The leverage should be sufficient to enable the motorman to exert a pressure on the brakeshoes at least equal to the weight of the car, and the brake gear should be proportioned throughout for the strain due to the maximum leverage. Were these precautions taken, the failure of brakes on an electric car would be an unheard-of occurrence.

A question which deserves some attention in this connection is whether in the interests of safety the limiting grade on electric car lines should not be that at which the car will stop, supposing the brakes to be locked and the wheel sliding on a greasy rail. If we may trust the Cincinnati papers, in one of the recent street car accidents in that city a car with its motor disabled on a steep grade started down the hill with the wheels sliding. Is not a grade on which such an accident could occur steeper than should be operated? What grade this would fix as the limit for street railway work is uncertain. Experiments on the Paris, Lyons & Mediterranean Ry., in France, in 1851, showed a coefficient of friction of .11 between the wheel and the rail for a railway car with wheels locked and sliding, moving on a damp rail at a speed of 18 to 20 miles per hour. This would give a 11% grade as that at which the friction of the sliding wheels would equal the accelerating force due to the grade. In street railway service, however, the rails are liable to be coated with a slimy street mud, which, acting as a lubricant, must considerably dimin'sh the coefficient of friction. If rails on steep grades are liable to this, it seems a fair conclusion that the limiting grades should be made much lower than is common practice at present.

The alternative to this, and one which deserves attention from those in charge of street railway lines with very steep grades, is the adoption of some auxiliary method of traction on the steepest grades. Such methods, indeed, are already in use. The auxiliary counterbalance system in use at Portland, Ore., and Seattle, Wash., was described and illustrated in our issue of June 29, 1893. The ingenious central rail system devised by Mr. H. L. Van Zile, of Albany, N. Y., was shown in our issue of Sept. 8, 1892. While the cost and complexity of any such additional devices will be considered an argument against them by street railway managers, it will eventually be found in street railway traffic as on steam railways that safety must be made the paramount consideration. The rapidly increasing number of accidents on electric railways is attracting much attention, and greater efforts ought to be made on the part of those responsible to remove the causes of these unfortunate occurrences.

LETTERS TO THE EDITOR.

TESTING MACHINES AND THE NIAGARA SUSPENSION BRIDGE.

Sir: In a communication over the signature of Jno. R. Matinck, Jr., published in your issue of Sept. 7, reference is made to the importance of a certain testing machine in saving the Niagara Suspension Bridge, which, in truth, must prove "a lively source of satisfaction to engineers to see the instrument." Perhaps you will be good enough to permit the "other engineers" referred to in the article to place upon record the actual facts in the case, leaving to your readers to judge where the line may be drawn between advertising license and professional etiquette.

The first examination, made by T. C. Clarke in 1873, showed that the cable wires, imbedded in masonry, were somewhat corroded, and that the wooden floor beams were dangerously decayed. On the promise of the company that the floor beams should be at once taken out and replaced, and that further examination should be made, the bridge was allowed to be used for trains of not over six cars and a light engine, moving not faster than five miles an hour, until new floor beams were put in.

Colonel Paine and ourselves, "the other engineers," were appointed as experts in 1877, to further examine and report upon what should be done. It was found that not only were the wires of the cables much corroded where they had been imbedded in the masonry, but also that the anchorage bars were so badly proportioned in the eyes and pins that they had only about 60% of the strength of the cables. The remedies proposed were as follows: 1st. The corroded ends of the wires were cut off and new ones spliced on with the "Paine splice," which tests showed gave strength equal to that of the solid wire. To satisfy us that the rest of the cable was unimpaired, Colonel Paine devised the ingenious testing machine exhibited by Riehle Bros., which showed that certain loads gave the same extension as the late John A. Roebling had observed and recorded on the original wires. 2d. The anchorage was reinforced by the addition of enough bars to give it a strength somewhat greater than that of the cables. 3d. The whole wooden system of the trusses and floor was rebuilt in steel. All this was done by Mr. L. L. Buck, in general accordance with the report made by us, but with one remarkable exception. We were not able to convince ourselves that these changes could be made while the bridge was being used for traffic. Mr. Buck took a different view, and not only reinforced the anchorage and reconstructed the trusses in steel, but also replaced the stone towers with steel ones, without stopping traffic over the bridge. This we believe to be the most daring feat of bridge erection ever performed anywhere or by anybody.

Summing up the whole matter: The bridge was not condemned by "the two other engineers." It was not saved by the use of the "testing machine." It was made safe by renewing the ends of the cables, the trusses, floorbeams, anchorages and towers, leaving nothing of the original structure but that part of the cables which was still uncorroded. What Colonel Paine, who was a very accurate man, probably did say was, that his instrument saved the cables of the Niagara Suspension Bridge.

Charles Macdonald,
New York, Sept. 12, 1893. Thomas C. Clarke.

IRON BRIDGES VERSUS TORNADOES.

Sir: Seeing no reply to the letter of "T. C." in your issue of Aug. 17 entitled "Iron Bridges Versus Tornadoes," I wish to say for his information that, if newspaper reports are true, the iron railway bridge across the Missouri River at Kansas City, Mo., was completely wrecked, being twisted apart and thrown from its piers, by the cyclone that swept that city in the spring of 1886. By the same authority a new cantilever bridge at Niagara Falls was totally wrecked a few years ago. Very truly yours,

Evansville, Miss., Aug. 30, 1893. C. A. B.

A copy of the above letter was submitted to "T. C." who returns the following reply:

Neither of the cases named by this correspondent prove anything in reference to the action of tornadoes on iron bridges. The Kansas City span was, I believe, a wooden combination truss of an unsatisfactory design. The bridge at Niagara was a wire suspension bridge, and gave way through some defect in the anchorage of the wind braces. The other bridges at this point were unaffected by the storm. T. C.

Sir: In answer to T. C.'s inquiry for information as to the effect of tornadoes upon iron railroad bridges, I will state that he can find an excellent account of the effect of one upon a railroad bridge of 102 ft. span, in Vol. II., p. 255, of the Journal of the Association of Engineering Societies," it being a paper read in June, 1883, before the Civil Engineers' Club of Cleveland, by Mr. H. M. Claflin. P.

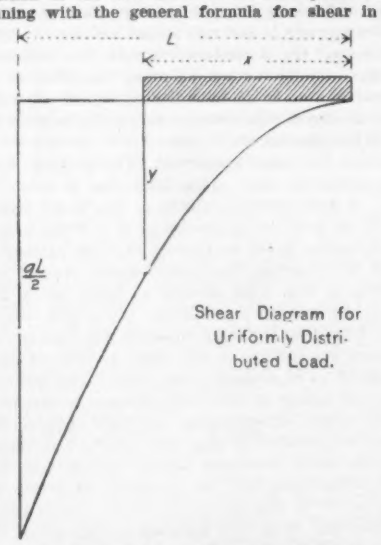
Cleveland, O., Sept. 6, 1893.

(The paper referred to gives a copy of the official report to E. B. Thomas, General Manager of the C., C., C. & I. Ry., on the destruction of an iron bridge over Shoal Creek, at Hillsboro, Ill., on May 18, 1883. The report is signed by W. C. Irwin, Engineer of Bridges, and W. Renschel, Assistant Engineer. Mr. Irwin was Chief Engineer of the Bee Line and afterward of the Big Four system from 1885 to 1893, and is now Consulting Engineer of the Central Trust Co., of New York city. The bridge wrecked was a through Whipple truss 102 ft. 7 ins. c. to c. of end pins, weighing 57½ tons, and was built in 1882 by the Cleveland Bridge & Car Works. It was designed to resist a wind velocity of 75 miles per hour, at which the main members would not be strained over 10,000 lbs. per sq. in. and the laterals 15,000 lbs. The cyclone apparently lifted the floor system up against the top laterals and then tore the bridge from its foundations. The report claims that a pressure of not less than 333 lbs. per sq. ft. must have been exerted. The paper by Mr. Claflin also refers to the destruction of a 250-ft. span at Omaha, and the derailing of a locomotive, at East St. Louis, the latter being removed entirely from the track to an adjoining field. Dates and particulars of these latter occurrences are not given. Perhaps some of our readers can give further information.—Ed.)

CONCERNING SHEAR FROM A UNIFORMLY DISTRIBUTED LOAD.

Sir: In your issue of Sept. 7 there appeared a letter from Wm. F. Waag, C. E., of St. Louis, in which he gives the formula for obtaining the shear at the front end of an advancing uniformly distributed load, and, referring to the fact that "the equivalent uniformly distributed load per lineal unit causing the same vertical shearing force as a system of concentrated axle loads is a function of the character of the system of concentrated loads and its position on the span, but is independent of the total length of the span," he asks "when and where the above law has been published first," adding "to my knowledge it has not been published so far."

There is nothing new in the formula; it may be found (not perhaps in that exact form) in any good treatise on bridge strains and structures. In Chapter II. of the 1886 edition of Professor Du Bois' book this subject is fully treated. In a letter of mine which you published Aug. 15, 1891, I gave an original derivation of the formula for maximum panel shear, beginning with the general formula for shear in the



Shear Diagram for Uniformly Distributed Load.

exact form in which Mr. Waag presents it. It may be interesting to study the connection between the law and the formula cited in Mr. Waag's letter.

We know that as a uniformly distributed load advances the shear at its forward end is always proportional to the ordinate to a parabola at that point. (Dead load is not included in this discussion.)

If L is the span (see figure) and x the distance covered by the load, y will be the ordinate giving the value of the shear sought. When the whole span is loaded, x = L, and the ordinate y here becomes the end reaction, which we know to be ½ g L, where g = uniform load per linear unit.

From the property of the parabola we have the proportion:

$$\frac{y}{x^2} = \frac{\frac{1}{2} g L}{L^2} \quad \ldots\ldots (1)$$

whence

$$y = \frac{x^2 g}{2 L} \quad \ldots\ldots (2)$$

or using Mr. Waag's notation,

$$S = \frac{l^2 g}{2 L} \quad \ldots\ldots (3)$$

Diagrams such as the one shown by Mr. Waag may be constructed whenever the product or the quotient of two variables is a constant quantity.

It is evident that we may write equation (1) in the three following forms:

$$\frac{y}{x^2} = \frac{g}{2 L} \quad \ldots\ldots (4)$$

$$\frac{y}{g} = \frac{x^2}{2 L} \quad \ldots\ldots (5)$$

$$2 L y = g x^2 \quad \ldots\ldots (6)$$

If either member of any of these equations be put equal to a constant, a diagram may be made expressing the simultaneous values of the two terms in the member. Both members of any one equation are equal to the same constant, and two diagrams might be made showing all the various combinations of values of the terms. The diagram shown by Mr. Waag is constructed by putting the second member of the equation (6) equal to a constant; and his law states that the various values of g in this diagram are independent of L. This is true; but it is necessary to know L before y (the shear) can be found, since the product of L and y is constant. In other words, having found the equivalent uniform load per linear unit for any given distance from the end of the span, the value of the shear at that point will be less the greater the span, and vice versa. Yours truly,

Wm. W. Crehore.

New York, Sept. 12, 1893.

Sir: In regard to the action of an evenly distributed load on bridges under conditions referred to by Mr. Waag in Engineering News of Sept. 7, I would refer him to the first edition of Winkler's "Bruckenbau," or Bridge Building. On page 31 he will find the same law set forth with the same illustrative diagram used by Mr. Waag. He will find a copy of Winkler in the library of the Am. Soc. C. E. (5 F, 3051). I also remember seeing the same law used in a report of a committee of the "German Technical Society in Bohemia," which investigated the Austrian bridge laws of 1870. Its origin may be even more remote. In the words of Ben Akiba—There is nothing new in the world. Yours, Fr. von E.

New York, Sept. 12, 1893.

THE PURCHASE OF THE SYRACUSE WATER-WORKS.

Sir: The interesting paper by Mr. Stephen E. Babcock relative to the municipal acquirement of the plant of the Syracuse Water Co., which appeared in your issue of Sept. 14, while giving in great detail the names of the various commissioners, counsel and experts engaged in the case, omits to make mention of the fact that in my report to the Syracuse Water Commissioners, dated Jan. 28, 1889, the recommendations of which report have been the the basis of all the work done with reference to the Syracuse water supply, I used the following language relative to the purchase of the Syracuse Water Co.'s plant by the city:

"I estimate that to build and equip new works of equal extent and capacity of supply would cost at the present time $850,000. Taking into account, however, the deterioration of the plant, particularly the bad condition of the reservoir and the older lines of pipe, the actual present value of the works is considerably less, but when, on the other hand, we consider the inconvenience which would be caused to the public by a wholesale change at this time, and the value of the rights and franchises, the amount named would probably suffice to compensate the water company and the people for the transfer." The amount awarded by the Commissioners of Appraisal was $850,000. J. J. R. Croes.

New York, Sept. 15, 1893.

ARTIFICIAL FUEL IN FRANCE.

Sir: In your remarks upon the patent fuel, "eggette coal," in your issue of Sept. 7, you say, in substance, that fuels of this class, under great heat, run into a fluid, sticky mass. For many years "briquette" has been used in France in the furnaces of locomotives, steamboats, etc., with good results. It is made of fine washed coal (slack), with a very small quantity of coal-tar, formed under pressure into large bricks, which are broken up for use. Some coals need no binding material, but by means of heat and pressure are given sufficient strength. W. R. Hutton.

New York, Sept. 13, 1893.

NOTES AND QUERIES.

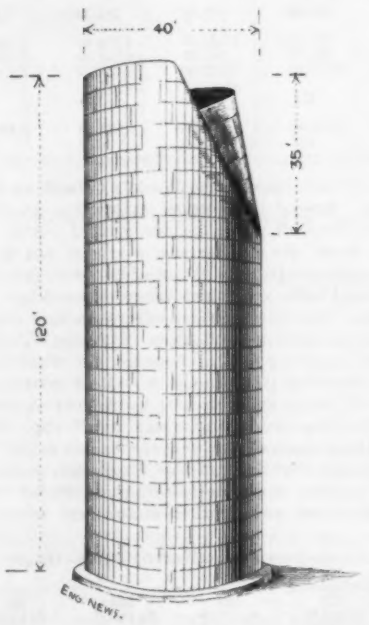
L. H. W., of Milton, Ind., asks concerning the best formula for mixing cement for pavements. We assume that he means foot-walks, and give the following: For

bottom coat, 1 barrel Portland cement, 2 barrels sand and 5 barrels of broken stone. For the surface coating use Portland cement and sand, 1 to 1; the natural soil should be removed to a depth of 8 ins. below the finished level, and after all objectionable matter is removed a layer of clean gravel, broken bricks or steam ashes is to be put down and well consolidated to a depth of 4 ins. On this place 3 ins. of the concrete thoroughly rammed, and after the concrete is set finish with a 1 in. layer of the wearing coat, troweled to the required grade. Keep traffic off this pavement for about 15 days.

A STAND-PIPE SUCCESS AT EAST PROVIDENCE, R. I.

An instructive instance of the effect of high wind pressure on a nearly completed stand-pipe occurred on Sept. 7 at East Providence, R. I., as noted briefly in our issue of Sept. 14. More complete information regarding the gale and its effects has been received from Mr. J. J. Luther, Superintendent of the water-works of the East Providence Fire District, under date of Sept. 15, as follows:

In answer to yours of recent date I would say that the stand-pipe is not a failure but a success. In the gale that we had here about 10 days ago it blew hard enough to raise the pipe on the windward side some 4 or 5 ins. It would spring in and out and rattle like a sheet of zinc when shaken. We pumped it full of water the next day, the first water that had been in except to test the bottom, and it leaked the least trifle. Sept. 7 we had a heavy blow all the afternoon.



Effect of Wind on Partially Completed Stand-Pipe, East Providence, R. I.

About 7 p m. a cyclone struck us, lasting 10 minutes, which knocked or dented in the top of the pipe for 35 ft., as shown in the accompanying sketch. It sprung into shape before I could secure a photograph. We pumped 85 ft. of water into it, which, with the strain from a tackle fastened to the dented rim, sprung it out instantly, the same as pushing out a dent in a hard felt hat. We pumped it full to the brim, 120 ft., and, to our surprise, found but one leak, where it had strained a few rivets at the bottom of the bend. The contractors have cut out and replaced some 4 or 5 ft. of riveting, and it seems just as good as new. It shows two wrinkles where the bend was the sharpest, which they propose to pound out with wooden mauls.

Extract from Contract.

This stand-pipe to be cylindrical in form, 40 ft. in diameter and 125 ft. high and made of first-class American rolled steel, whose resistance to tensile strain shall be equal to 60,000 lbs. per sq. in. of section. The bottom of the stand-pipe is to be ⅜ in. in thickness and 41¼ ft. in diameter, formed of radial strips bedded in a layer of neat Portland cement and brought to a true level. The lower course of plates is to be secured to the bottom plates by a 6 × 6-in. angle iron, with two rows of 1-in. rivets, not less than 2¼ ins. c. to c., rivets spaced 2½ ins. apart, alternate to each other, or staggered. The courses are to be built 5 ft. high, and the thicknesses are as follows: The first or lower course to be 1 9-32 in.; second, 1 3-16; third, 1 5-32; fourth, 1 1-16; fifth, 1; sixth, 15-16; seventh, ⅞; eighth, 13-16; ninth, ¾; tenth, 11-16; eleventh, ⅝; twelfth, 9-16; thirteenth, ½; fourteenth, ⅜; fifteenth, 7-16; and sixteenth, 7-16; seventeenth to twentieth, ⅜; twenty-first to twenty-fifth, 5-16.

The facts given above speak well for the character of the material and workmanship of the structure and also show the wisdom of the generally accepted idea that the top rim of a stand-pipe should be strengthened by an angle iron or some other efficient method. The top ring of this pipe, it must be remembered, had not been put on. The contractors for the structure were the Cunningham Iron Works, South Boston, Mass.

AN IMPROVED TEE RAIL FOR ELECTRIC STREET RAILWAYS.

By John A. Beeler, Constructing Engineer, Denver Tramway Co.

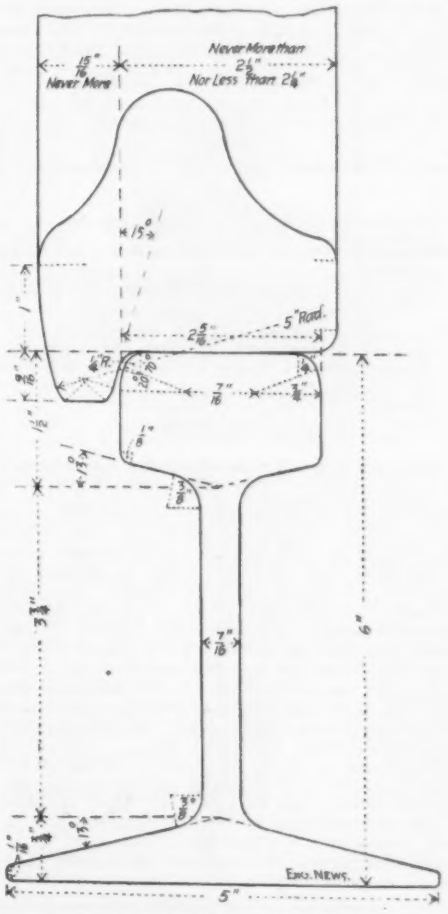
It must be recognized that electric travel in a paved street requires a section of tee rail different from that of a steam road. Here we have constant friction, starts and stops and dust and sand, making the action of the motor wheels a constant wear on the head of the rail. The accompanying cuts show a rail, designed by the writer, and now being used by the Denver Tramway Co., Denver, Colo., together with the standard wheel section and paving used with it.

The head of this section is especially designed to present all the surface possible to the tread of the wheel, not only giving a better contact but providing an ample bearing for friction. It thus not only requires less current for starts, but both the starts and stops will be made in less space than where a smaller and more rounded head is used. The base is sufficient in width to hold it in alinement without the use of tie-rods or other appliances, such as are used on most high rails, which not only increase the cost of construction, but maintenance as well. It will not cut into an ordinary red spruce or pine tie under the heaviest electric traffic even when the tie is placed upon a concrete base, which is the severest test I know of.

This rail is the same height as the ordinary stone or granite paving block, which may be cut to fit the rail, or a wooden strip may be placed parallel to and under the ball of the rail, and the paving placed against it. In this manner it is impossible for the pavement to bulge, as it does in most instances where the rail is used on chairs. Usually the constant pounding and hammering of the dust and minute particles of dirt and sand by the wheel flange forces it down along the neck of the rail, where it settles under the stone toothing or blocks and raises them slowly but surely.

A wagon or carriage wheel that happens to get into the flangeway experiences no difficulty in turning out, owing to the slight variations of the paving blocks, which the long, smooth lip of the girder rail makes almost impracticable without giving the wheel of the vehicle a severe wrench.

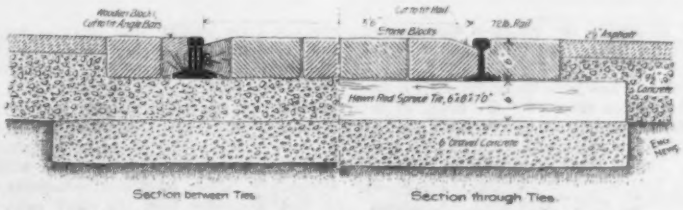
This section is proportioned as nearly as possible to give uniformity in cooling, so that only about the ordinary quantity of "seconds" will be produced in rolling. The straightening is brought down to a minimum for a rail of this height, which adds greatly to the life of the rail. Too much straightening, as we all know, distorts the metal and impairs its vitality. The rails for an electric road should be rolled harder and contain a higher percentage of carbon than those used for an ordinary steam road. Here the rail never gets the tremendous blows and heavy weight of an 80-ton locomotive that affects the whole of the rail from the base to the head, and would break a too hard rail in pieces, but it gets the steady emery-wheel-like action of the motor wheels that affects principally the head and bearing surface of the rail. This has been confirmed by our actual experience here during the past four years. Since designing this rail it has been adopted by the Salt Lake City St. Ry. and rolls have been made by the Illinois Steel Co.



Section of Standard Rail and Wheel Tread, Denver Tramway Co.

RELATIVE COST OF HEAVY VS. RE-INFORCED BRIDGES.

Mr. Albert F. Robinson, Engineer of Bridges and Buildings, Chicago, Rock Island & Pacific Ry., contributes to the "Technograph," of the University of Illinois, the following interesting and valuable study of this question, which shows clearly that true economy tends heavily in favor of making bridges heavy enough for all future requirements in the first place. Unfortunately, the question of expediency involves one other and most important issue not involved in the question of economy, viz., whether the management are willing to invest money in permanent improvements at 5% compound interest instead of using it for dividends. Except for this issue, which is always likely to be considered seriously and sometimes very properly, Mr. Robinson clearly rather underestimates the financial disadvantage of building bridges just strong enough to pass and strengthening them later. Had he chosen a shorter period than 15 years, moreover (and in most cases it has been shorter) his comparison would have tended still more in favor of building bridges once for all, strong



SECTIONS OF STANDARD TRACK, DENVER TRAMWAY CO.

enough for any possible requirements; like Brunel's Saltash Bridge, which antedates all American bridges by some decades, and bids fair to outlast most of them by more decades than it antedates them.

In 1882 and 1883 the writer had charge of the designing and construction of some heavy iron bridges for one of our best Western railroads. At that time the bridge companies bidding on these structures considered them unusually heavy; but during the past season several of these bridges were taken down and reinforced because they were already considered too light for the service required. The writer has frequently found it necessary to urge the use of heavier bridges, and the notes prepared for such discussions have suggested the following tables:

Table I. shows a comparison between the cost of building a light bridge and afterwards reinforcing it, and the cost of building the heavier bridge originally. Only single-track structures are considered, though the same relative proportion of cost and weight doubtless exist in double-track bridges.

The bridges built in 1882 were according to the Erie specifications of 1879, and the "heavy bridges" are in accordance with the Lehigh Valley specifications of late date. The actual "shipping weights" were used in nearly every case. The prices, 4.7 cts. and 5.1 cts. per pound for the work erected and painted, are the lowest of which the writer has any record for the year 1882. During the year just passed the prices for bridge work have been about 3.75 cts. per pound for girders up to 80 ft. and 4 cts. per pound for truss spans of ordinary length. These prices include erection, painting and freight to Chicago, Ill.

The reasons for taking 15 years as the period for comparison are: 1. It is almost 15 years since the first Erie specifications were published (about the limit of our observation for purposes of comparison). 2. A large portion of the bridges which were fully up to the requirements at the time they were built, have had to be reinforced within less than 15 years. 3. It is hardly safe to predict the probable direction or rate of increase in the rolling load for a greater period than 15 years.

In Table I. no charge has been made for freight between the bridge and the shops, for the delay or interruption of traffic on account of the work, or for the danger from floods when the track is carried on temporary falsework. Taking these items into the account, we may conclude that any time during the past 15 years, the heavier bridge would have been the cheaper.

Under "cost of reinforcing bridges after erection" (see the second portion of Table I.), the price for the new part of the work has been taken at 3.25 cts. per pound, not including cost of erecting and painting. New bridge work is 3.25 cts. per pound, excluding cost of erecting and painting, but reinforcing old work is always more expensive per pound of the new material added than entirely new bridge work.

The cost of lower falsework for carrying teams and supporting iron and upper falsework during erection was estimated as follows:

Cost of Falsework for Carrying Traffic.

Items of Cost.	Spans less than 100 ft.		Spans 100 to 200 ft.	
Cost of new falsework per lineal foot of track	.....	$8.00	.....	$9.50
Relaying track after putting in new floor*	.....	.30	.....	.30
		$8.30		$8.30
Value of falsework after use, per lineal ft. of track.	$4.00	.....	$4.50	.....
Cost of removing falsework..	1.00	.....	1.00	.....
Net value of old falsework, piled on bank ready for loading	$3.00	$3.00	$3.50	$3.50
Net cost of false work per lineal foot of track	.....	$5.30	.....	$6.30

* This does not include the cost of new bridge ties or their framing.

In computing this table the caps were assumed to be double or treble, and the lower or main caps not less than 22 ft. long. Sway-bracing and piling are used as in ordinary pile bridges, but the piles are frequently of pine or some cheap timber. The stringers are not usually bolted together, but are so arranged that they can be easily removed.

On a road built in a large river valley where side streams had to be crossed near their mouths, the total pile and timber trestle bridging averaged about 280 lin. ft. per mile of road. The average cost of this bridging was a little more than $10 per lin. ft. On a line in Kansas and Colorado, averaging less than 100 ft. of bridging per mile, the cost was from $10.50 to $13 per lin. ft. of bridge. In view of these facts the prices assumed for falsework can hardly be considered as too high.

Judging from the past it is safe to assume that the rolling load will continue to increase for some time to come. The reasons for this are: 1. This increase may not be proportionally so great as in the past, but the uniform train loading may increase much faster than the concentrated engine wheel loadings. 2. Even though steam be superseded as the motive power, it is hardly probable that the maximum car loads will be reduced; on the contrary, this may result in increasing them. It is not likely that the demand for cars to carry extra heavy pieces of machinery will cease. This demand has steadily kept pace with the increased strength of rolling stock and permanent way, and has, in fact, generally been the chief cause for these increases. 3. Competition and the demands of the traveling public have been continually for a higher average speed for trains of all classes. At present it is not uncommon for special classes of valuable freight to be carried at express train speed. The higher rate of speed for all classes of business must cause greater wear on bridges and this will naturally call for heavier structures.

With the prevailing tendency towards heavier service in view, the writer has prepared the second table giving the cost of heavy bridges at present market prices and shows the percentage that can be added to the weight (when the structures are built), without having the extra cost amount to more than the prospective cost of reinforcing after 15 years.

Table I. Showing Relative Cost of Constructing an Ordinary Bridge in 1882 and Reinforcing It After 15 Years, and of Constructing the Heavier Bridge Originally

Items of Cost.	Span, in feet, between pin centers. 40	50	60	80	100	120	140	160	180
1. Cost of bridge in 1882 at 4.7 cts. per lb. up to 80 ft	$901.10	$1,344 20	$1,816.20	$3,036.20	.....	.....	.....	.....	.....
5.1 cts. per lb. beyond 80 ft.	.....	.....	.....	.....	$4,539.00	$6,018.00	$7,792.28	$9,929.70	$11,679.00
2. Increase in weight to have made the bridge safe for the heavier loading	9.5%	16%	14%	17.5%	15.75%	23%	22.7%	21.6%	22.25%
3. Additional cost to have made bridge safe for the heavier loading.	$86.20	$216.20	$253.80	$531 10	$714.00	$1,377.00	$1,744.20	$2,148.10	$2,601.00
4. Amount of this additional cost, in 15 years, at 5% compound interest	179.30	449.70	527.90	1,104.70	1,485.12	2,864.16	3,627.94	4,465.97	5,410.08
5. Cost of reinforcing after erection:									
material and shop work at 3.25 cts. per lb	59.60	149.50	175.50	367.25	455.00	877.50	1,111.50	1,368.25	1,657.50
Taking down and loading bridges at 0.25 and 0.30 cts. per lb., respectively	.....	.....	.....	161.50	222.50	354.00	458.40	584.10	687.00
Erecting and painting at 0.5 cts. per lb	105.67	166.00	220.00	.....	.....	.....	.....	.....	.....
Erecting and painting at 0.6 cents per lb	.....	.....	.....	455.40	618.00	876.50	1,122.00	1,428 00	1,680.00
Lower falsework for carrying trains	212 00	265.00	318.00	424.00	630.00	756.58	882.00	1,008.00	1,134.00
Total cost of reinforcing	377.27	580.50	713.50	1,408 15	1,925.50	2,857.30	3,573.90	4,388.35	5,158.50
6. Proportion of cost of reinforcing to first cost of bridge	41.4%	43%	39.25%	46%	42%	47%	46%	44%	44%
7. Amount which, at 5% compound interest, will, in 15 years, equal the cost of reinforcing	$181.33	$279.09	$343.03	$677.00	$925.72	1,3 3.80	1,718.22	2,109 80	2,480.05
8. Proportion of this amount to first cost of bridge	20%	21%	19%	22%	20%	23%	22%	21%	21%

Table II. Showing Relative Cost of Constructing an Ordinary Bridge in 1892, and Reinforcing It After 15 Years, and of Constructing the Heavier Bridge Originally

Items of cost.	Span, in feet, between pin centers. 40	50	60	80	100	120	140	160	180
1. Cost of ordinary bridge in 1892 at 3.75 cts. per lb	$792.54	$1,244.00	$1,650.00	$2,845.75	$4,120.00	$5,800.00	$7,480.00	$9,472.00	$11,200.00
2. Estimated increase in weight	9.5%	16%	14%	17.5%	15.75%	23%	22.4%	12.6%	22.25%
3. Additional cost of above increase in weight	$158.51	$248.80	$313.50	$569.35	$824.00	$1,276.00	$1,645.60	$1,989.12	$2,352.00
4. Amount of this additional cost in 15 years at 5% compound interest	329.70	517.50	652.08	1,184.15	1,713.92	2,654 28	3,422.85	4,137.37	4,892.16
5. Cost of re enforcing after erection:									
Material and shop work at 3 ct. per lb	126.81	199.20	250.80	455.40	618 00	957.00	1.234.20	1,491.84	1,764.00
Tearing down and loading at 0 25 and 0.3 cts per lb. respectively	.....	.....	.....	189.75	309 00	435.00	561.00	710.40	840.00
Erecting and p inting at 0.5 and 0.6 ct. per lb. respectively	126.81	239.04	261.80	455.40	741.60	1,061.40	1,368 00	1,719 17	2,032.80
Lower falseworks for carrying trains	212.00	265.00	318.00	424.00	630.00	756.00	882.00	1,008.00	1,134.00
Total cost of re-enforcing	465.62	703.24	830.60	1,524.55	2,298.60	3,209 40	4,046 01	4,929 41	5,770.80
Additional cost in 1892 of making bridge safe for the heavier loading	158.51	248.80	313.50	569.35	824.00	1,276.00	1,645.60	1,989.12	2,352.00
Amount which at 5% compound interest will in 15 years equal cost of re-enforcing	223.85	338.09	399.32	732.95	1,105.10	1,542.98	1,915.21	2,369.90	2,774.42
Amount which at 5% compound interest will in 15 years equal the extra cost of making the bridge strong strong enough for the heaviest traffic	329.76	517.50	652.08	1.524 55	1,713.92	2,6 4.28	3,422.85	4,137.37	4,892.16
Total cost of re-enforcing the bridge	465.62	703.24	830.60	1,184.15	2,2,98.60	3,209.40	4,046.01	4,929 41	5,770.80

RAILWAY IMPROVEMENTS FOR THE WORLD'S COLUMBIAN EXPOSITION.—VII.

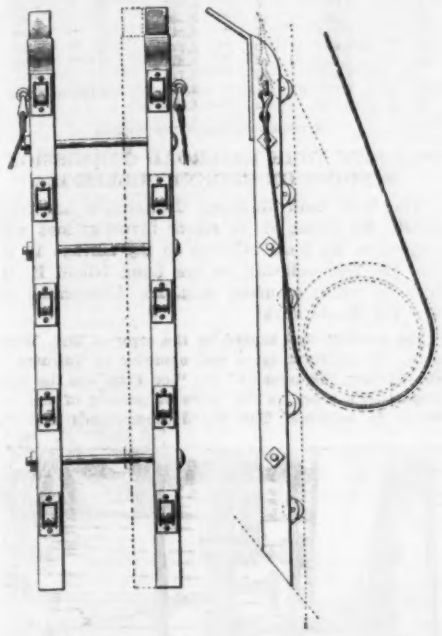
Atchison, Topeka & Santa Fe R. R.—We are indebted to Mr. John E. Frost, Land Commissioner, for the following statement in regard to the preparations made by this road in connection with the Exposition traffic: "Our company has not made any special additions to track or buildings, but purchased, in the latter part of last year and first of this year, 20 locomotives, 40 chair cars, 10 passenger coaches and 8 baggage cars, in view of the probable increase in our passenger business this year, and having especially in view the increase of traffic during the World's Columbian Exposition. Special Exposition excursions are being run from all points on our system (which is, as you know, the most extensive system and longest continuous line in the world) clear through from the Pacific coast and intermediate points to Chicago. The rates for these excursions vary somewhat in proportion to distance, with approximate rate of one and one-third fare for the round trip on all first-class trains, and periodical excursions on special dates under special restrictions at rates approximating one fare for the round trip. The Land Department of our company has an exhibit in the Kansas Building, at the Exposition, consisting of a series of panels tastefully decorated with Kansas grain, and bearing ornamental lettering calling attention to our line and farming lands, and also paintings of various scenes of interest, especially illustrating the farming and educational features and leading industries of the state, such as salt production, zinc and lead smelting. In connection with this, we have a miniature train which is a counterpart of one of our regular vestibule trains drawn by an engine appropriately named "J. W. Reinhart," after Mr. Reinhart, the President of the Atchison system. This train is propelled by electricity, and is constantly in operation during the regular hours of the Exposition."

A CONVERTIBLE SKID OR TRUCK.

A new labor and time-saving device in the form of a convertible skid or truck has been invented by Mr. Maurice Munchweiler, of St. Louis, Mo. As

a skid the device is intended to more easily and rapidly handle heavy packages of merchandise and especially in loading and unloading the same from wagons, and as a truck, or car, it is employed in transporting packages or machinery.

The illustration, given so plainly, sets forth the purpose and simplicity of this device that little further description is necessary. It differs little from the ordinary skid in use, except in the important addition of the rollers on the outer surface. In practice it is found that the principal damage



The Munchweiler Convertible Skid or Truck.

to goods handled on the old sliding skid results from the twisting and wrenching which the packages undergo in transit. The rollers obviate this trouble and enable packages up to 3,000 lbs. in weight to be handled with comparative ease. The rollers have proved themselves particularly advantageous in handling crates of glass and crockery, as they are so adjusted that the weight to be moved on the skid always rests on two or more rollers, and each thus bears its due proportion of the load. The upper ends of the skid are perfectly rounded and being also provided with rollers a box can be pushed forward on these rollers until the excess of weight is beyond them and the package is in a position to reach the lower rollers on the skid. Experience has shown that for use in the rapid handling of steamboat freight and in piling up boxes and barrels in a storehouse this device is to be especially commended.

The skid reversed answers as a truck, and being low and near the floor it is found to be an excellent device for moving heavy machinery from one place to another. Any inquiries concerning this skid and its further use should be addressed to Mr. Felix Haac, 311 Walnut St., Philadelphia.

CANAL EXCAVATING BY HYDRAULIC POWER.

In the "Annual" of the Engineering Society of the University of Georgia, Mr. B. M. Hall describes the method by which the Suwanee Canal Co. is cutting an outlet canal for draining the Okeefenokee swamp, in Charlton County, Ga. This swamp is a shallow, fresh-water lake covering an area of 400,000 acres with much good timber on the numerous islands. The swamp lies on an elevated plateau 116 ft. above hightide, in the St. Mary River, and the top of the narrow vein dividing it from the river is 32 ft. above the swamp level with the land, a mile farther from the swamp is below this level.

To cut through this ridge and to form an outlet to the river a narrow channel was first dug 17 ft. deep at the summit and level on the bottom, which was thus 15 ft. above swamp level. At the swamp end of this channel a pumping plant was placed made up of two 80-HP. boilers and two 14-in. centrifugal pumps lifting 30,000 gallons per minute into a flume emptying into the dug channel.

To assist in loosening the material to be moved by the water, what is called a porcupine harrow is employed. This is a round log, 10 ft. long and filled with harrow teeth, dragged up and down a 1,000-ft. course by two iron cables attached to the two ends of the log and passing over sheaves to a double draw, reversible hoisting engine placed at the end of the line. This harrowing loosened the earth and the heavy stream of water washed it into the head of a neighboring ravine and thence into a lower swamp. The cost of the present excavation on the outlet canal is placed at 2½ cts. per cu. yd.

Back of the pumping station a 3-yd. Bucyrus dipper dredge is digging a canal, 40 ft. wide and 8 ft. deep, toward the center of the swamp at the rate of 200 lin. ft. of canal in 12 hours.

RELATION OF EVAPORATION TO FORESTS.

Under the head of "Forest Influences," Mr. B. E. Fernow, Chief of the Forestry Bureau of the U. S. Department of Agriculture, discusses in Bulletin No. 7 the effect of forests upon climate and rainfall. Under the special head above given we find the following notes mainly taken from German experiments:

The amount of evaporation depends especially on the temperature, the wind and the amount of vapor already in the air. As the first two are much changed by the presence of forests, it is to be expected that the evaporation in and about woods would show some peculiarities. As some type of surface must be assumed as a standard for evaporation, the German practice is followed of taking that of water, and hence all reductions have been made in what follows to terms of evaporation from a water surface. The amount of precipitation is included in the comparisons, and the observations were carried on in the open field and in the forest.

From a diagram given in the bulletin, it is seen that the annual evaporation in the forests is about one-half of that in the open fields. The annual mean for 10 years' precipitation at the German station used was 34.3 ins. in the open fields. The annual evaporation in the open fields at the same station was 12.7 ins., and in the woods it was 5.4 ins. The corresponding percentages of evaporation were 37 and 16, showing a saving of 21% of the precipitation by the woods.

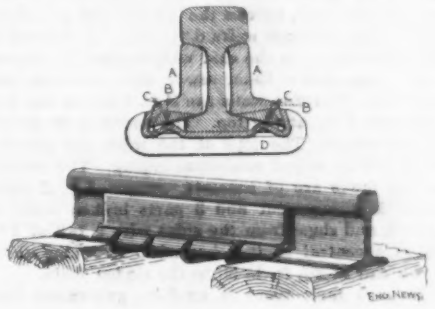
Other experiments show that the undisturbed forest litter on the ground has a great effect in reducing evaporation. Even with a saturated soil beneath, such a surface permits an evaporation of only 0.13% of that of a free water surface. According to observations on the evaporation from a water surface, about 5% more than the precipitation during the warm season can be disposed of by evaporation. Dr. Ebermayer says that the evaporation from the soil under forest litter is 13% of that of bare soil in the open in the warm season. As Dr. Ebermayer kept the soil constantly saturated, and this did not represent natural conditions, the Schubler value of soil evaporation in the open is to be preferred. By this latter the soil evaporates 0.60 as much water as a water surface sheltered from sun and wind. For different kinds of vegetation in the warm season the following table is given, showing the percentages of additions of moisture to the air due to evaporation from the several surfaces mentioned:

	Of evaporation from a free water surface.	Of precipitation.
Sod	1.92	0.96
Cereals	1.73	.86
Forest	1.51	.75
Mixed, etc.	1.44	.72
Bare soil	.60	.30

From this it appears that the forest is of medium activity in this regard and is usually surpassed by the average forage crops. The chief point is that the forest surpasses ordinary fallow growths and far surpasses the bare soil in storing precipitation. During continuous dry weather the roots of the grasses dry out the surface soil and exhaust its water, and there is a decrease in the amount of moisture poured into the air. Forests, on the other hand, may continue their transportation at such times and by protecting the soil beneath from excessive evaporation keep this soil charged with moisture and thus feed the tributary springs.

THE POPE RAIL JOINT.

The rail joint question still continues to be a favorite subject of consideration for inventors, and we illustrate this week a boltless joint which is exhibited at the World's Columbian Exposition by J. L. Pope, of Cleveland, O., and is said to have shown satisfactory results in experimental service tests. It consists of a base plate with an angle bar and two wedges on each side of the rail. The wedge B is placed between the bottom of the angle bar A and the top of the rail flange, while the wedge C is driven between the side of the base



The Pope Rail Joint.

plate D and the edges of the angle bar A and wedge B. Two projections stamped up in the base plate engage with notches in the rail flanges to prevent creeping. The joint is composed of but seven pieces, and in a modified form the wedges C are dispensed with. The claim made is that the downward pressure on the angle bars due to pressure and jar on the rails tends to force the wedges B outward and the wedges C upward, thus forcing the angle bars inward and maintaining a tight fit between all the parts, and as all the parts have large wearing surfaces there will be but little wear. Permanence and ease of construction are said to be special features of this joint.

SEWAGE PURIFICATION IN AMERICA.

(Continued from p. 217.)

Chautauqua, N. Y.

The following description of the chemical precipitation plant for the treatment of the sewage from the well known Chautauqua Assembly grounds was prepared by Mr. Thos. McKenzie, Resident Engineer, during the construction of the plant; we are also indebted to Mr. Wm. B. Landreth, M. Am. Soc. C. E., for the photographs from which the accompanying views were made:

Early in October, 1892, advertisements were inserted in the leading engineering papers asking for bids to build a complete plant for the sewage disposal of Chautauqua, the effluent to be clear and odorless and harmless to fish life, the plans and bids to be submitted to Mr. Samuel M. Gray, M. Am. Soc. C. E., Consulting Engineer. The plans and bid submitted by Mr. William B. Landreth, M. Am. Soc. C. E., of Jamestown, N. Y., were accepted and a contract entered into with Mr. Landreth at the annual meeting of the Board of Trustees of the Chautauqua Assembly, held in Pittsburg, Pa., on Jan. 17, 1893. Work was commenced April 1, 1893, under the supervision of Mr. Thos. McKenzie, Resident Engineer. The masonry work and machine-house were built by John W. Williard, of Jamestown, N. Y. The machinery was furnished and put in place by the Bonnot Co., Canton, O.

The machine-house is a wooden building, 40 × 40 ft. The sewage enters the building on the west side, the brick underpinning of the building forming one side of the brick channel. A screen made of iron bars, set sloping in the channel ¾ in. apart, catches all the heavier particles, which are raked off and disposed of by burning under the boiler.

The chemical mixers are two large wooden vats fitted with revolving arms, holding 850 gallons of solution (see interior view of Canton, O., plant,

Eng. News, Sept. 14, 1893). The first tank contains a milk of lime solution, which is applied to the sewage as it passes through the brick channel. A second tank holds the sulphate of alumina, which is also applied to the sewage as it passes through the channel.

After receiving the application of chemicals in the proper proportion, the sewage enters a brick mixing well where it is caught up by a vertical centrifugal pump and discharged again into the main channel to the tanks through a 4-in. discharge pipe. In this way the chemicals are thoroughly mixed with the sewage.

The tanks, which, with the machine-house, are shown by Fig. 84, are built of solid stone masonry in American cement mortar, lined on the inside with one course of brick in Portland cement mortar. The two end walls are 5 ft. across on the bottom and 4 ft. on the top. A brick channel 2 ft. wide, on the west wall, carries the sewage into any of the four tanks, through weirs 6 ft. long. A channel of like dimensions in the east wall carries the effluent over steps into a 15-in. sewer pipe emptying into the lake. The side walls are 3 ft. thick on the bottom and 2 ft. at the top. The partition walls are 2 ins. larger. The tops of the walls are covered with a 3-in. sawed sandstone coping. The bottom of the tanks are of concrete, composed of 2 parts sand, 1 part cement and 3 parts broken stone or gravel, and slope from the sides with a fall of 1 in 30 to a central sludge channel 2 ft. wide, which has a fall of 2½ ft. in 56 to the sludge drain.

In each tank there is an 8-in. galvanized iron floating outlet pipe, 8 ft. long, which is held suspended just under the surface of the water by a galvanized iron float. This floating outlet pipe is connected with the 15-in. drain under the end wall. When it becomes necessary to clean any one of the tanks it is shut off by means of the flash board, and, after a period of rest to allow all of the suspended matter to precipitate, the valve on the floating outlet is opened and the effluent drawn off down to the sludge. The effluent valve is then closed, and the sludge valve at the other end of the tanks opened, and the sludge passes into the sludge well through an 8-in. vitrified sewer pipe. The sludge well is of brick, 8 ft. in diameter, 16 ft. deep, with 12-in. walls, fitted with a cast iron cover flush with the machine-house floor.

The sludge is lifted from the sludge well by a centrifugal pump into a tank on the machine-house floor. From this tank the sludge is pumped into the filter press with a hydraulic pressure pump, shown in the foreground of Fig. 85, fitted with a double set of plungers and rubber valves resting on a cast iron seat. The valves are easily accessible in case they become clogged by waste or other fibrous material. The press (Fig. 85) is a 60-cell Bonnot press fitted with pressure gage and rubber gaskets. The sludge is pumped into the press until the gage shows a pressure of 60 lbs. and the water ceases to flow out of the drip cocks. The press is then opened, a car run under the press and the sludge removed out of the building. The cakes are 30 ins. in diameter, 1½ ins. thick. When first taken out of the press the average weight is 21 lbs., but after being thoroughly dried the average weight is 12 lbs., showing 43% of water still remaining after pressing.

Experiments as to the best methods and the amount of chemicals necessary to run the works were made by Mr. W. E. Landreth, M. Am. Soc. C. E., and Mr. Thos. McKenzie, Resident Engineer. The continuous plan, allowing the sewage to flow from one tank into the other, the effluent from the last tank down over the steps through the effluent pipe into the lake, was found to give better results than intermittent treatment, with less labor. By carefully watching the effluent and regulating the amount of chemicals until a good effluent was produced, the amount of chemicals used was found to be 18 grains of lime, 6 grains of alum and about ½ grain of copperas per gallon of sewage.

A sample of the effluent was sent to Prof. Maurice Perkins, member of the New York State Board of Health, and professor of chemistry in Union College, Schenectady, N. Y., for analysis. He says in his report, dated July 17, 1893:

I think this is quite a successful treatment of sewage. Most all of the albuminoid ammonia seems to have been precipitated, for originally I would expect to find at least ten times as much. I should have no hesitation in allowing an effluent like this to flow into a large body of water. Would have no fear as to the fish.

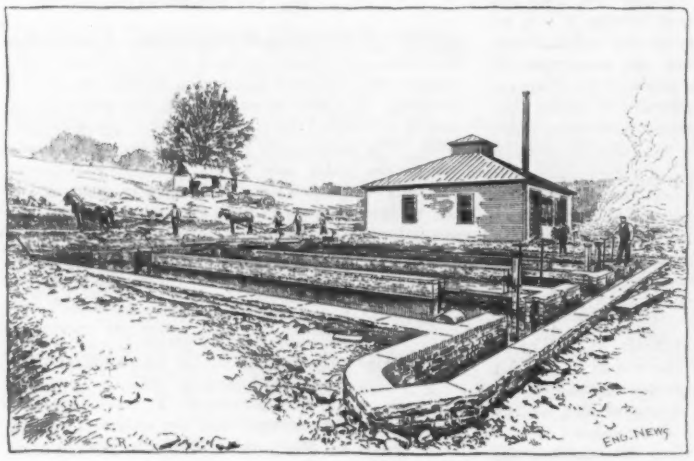


FIG. 84. VIEW OF SEWAGE SETTLING TANKS AND MACHINE HOUSE, CHAUTAUQUA, N. Y.

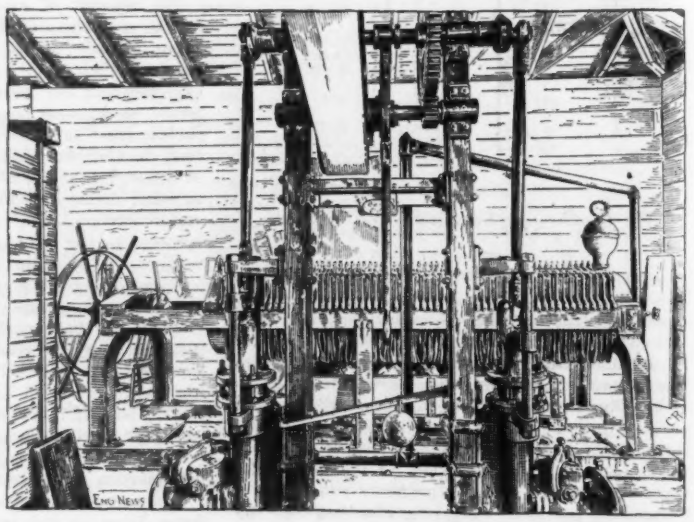


FIG. 85. INTERIOR VIEW OF MACHINE HOUSE, SHOWING SLUDGE PUMP AND FILTER PRESS, CHAUTAUQUA, N. Y.

Analysis of Chautauqua Sewage After Treatment.
(Parts in 100,000.)

Water turbid.
Uranous odor.
Specific gravity, 1.00063.
Solid residue (total), 75.
Mineral matter left on incineration, 24.
Chlorine 8.4, corresponding to 13.41 sodic chloride.
Free ammonia, 2.030.
Albuminoid ammonia, .6.
Nitrates, 0.
Nitrites, 0.

This effluent was sent to Mr. Perkins during the early attempts at purification of the sewage. Since these experiments have been made, experience in the management of the works and careful measurements of the flow of sewage combine to produce better results and no doubt an analysis of the effluent now would show even better results. It is estimated that there were on the grounds, at Chautauqua, about 4,000 people. An average of two presses of sludge per day has been taken out since July 15. The whole operation of emptying, cleaning the tank and pressing the sludge occupies about five hours.

Two men, an engineer and assistant, are employed at the works through the day from 7 a. m. to 6 p. m.; a third man then comes on and runs the works until midnight, when the flow of sewage ceases and the clear water is allowed to run through the brick channel in the building around the tanks in an open channel to the outlet pipes into the lake. The entire cost of running the plant averages $10 per day.

The sewerage and sewage disposal committee for the Chautauqua Assembly consists of Mr. Lewis Miller, Akron, O.; Dr. J. F. Edwards, Jamestown, N. Y.; and W. A. Duncan, Syracuse, N. Y., Secretary.

Sewer gagings made July 24, 1893, showed the following results:

Time.	Gallons per hour.	Time.	Gallons per hour.	Time.	Gallons per hour.
7 a. m.	4,416	4 p. m.	7,001	1 a. m.	2,902
8 "	7,001	5 "	5,655	2 "	2,800
9 "	7,601	6 "	3,336	3 "	2,803
10 "	7,916	7 "	4,847	4 "	2,800
11 "	7,432	8 "	4,847	5 "	2,800
12 "	7,432	9 "	5,224	6 "	3,662
1 p. m.	6,085	10 "	4,413		
2 "	7,432	11 "	3,313	Total.	122,884
3 "	6,516	12 "	4,093		

THE NEW YORK RAILROAD COMMISSION'S FINDING ON RECENT COLLISIONS.

The New York Railroad Commission has made public the result of its recent investigations with respect to the head collision on the Harlem R. R., and the rear collision on the Long Island R. R., both of which occurred Aug. 26. Concerning the first the Board says:

The accident was caused by the error of Wm. Wakeman, the assistant agent and operator at Towners, in substituting "Dykeman's" for "Ice Pond" in the train dispatcher's order as the place of passing of the two trains in collision. The board recommends that the requirement of Rule 509: "that the operators of stations, called for attention to train orders, shall listen to the repeated orders of the train dispatcher," shall be rigidly enforced; that the rule be amended so as to require that the train dispatcher shall first write his order before sending it, and shall check the repeated order by his original order in writing; and that the rule be further amended so that the conductor shall be required to telegraph to the train dispatcher what is his understanding of the order received by him, and shall not move his train until the train dispatcher shall subsequently order him to do so. The saving of time is unquestionably essential in the operation of a single track road, but time gained at the expense of safety leads to disaster. Had the requirement that the conductor should telegraph what his understanding was been in force, the accident under consideration would not have occurred.

We fear that if such a rule were put in force, it would be more honored in the breach than the observance.

The Board's finding respecting the Long Island collision relates the circumstances of the collision in detail, which differ in no important respect from the reports already given in this journal. The recommendations of the Board are as follows:

1. That block tower No. 5 (where the collision occurred) and the west bound home signal connected therewith be located on the bluff to the east of the present location of the tower, and that, in all instances, home signals be located so as to give the best possible view to the engineer of an approaching train.

2. That all engines and cars in the passenger service of said company be equipped with automatic air brakes.

3. That the portion of the road now operated by the block signal system, from Long Island City to Bushwick Junction, be also equipped with an automatic track circuit signal.

4. That the rules of the company governing the action of rear brakemen be amended so as to require that in all cases where it is necessary for them to go back for the purpose of protecting their trains, that they shall continue back until they meet the next approaching train or reach the next tower; this to apply to the portion of the road controlled by the block system only.

5. That in all instances home signals be located at the nearest possible available point to the tower from which they are operated.

6. That when the home signal is beyond the tower a clearance signal for the preceding block shall not be given until the markers on the rear of the train have passed such home signal. And when the home signal is before or at the tower, the clearance signal for the preceding block shall not be given until the markers on the rear of the train have passed the tower.

7. That all employees in towers and trainmen shall be subject to a rigid examination as to their qualifications for the respective positions they are to occupy and their habits of life, and that a strict supervision be exercised over them.

All the above recommendations are in accordance with common sense and sound engineering except the fourth, which is so palpably absurd that it will doubtless never be heard of again. If it is necessary for a train to leave its rear brakeman every time he goes back to flag, it would apparently be necessary to attach an extra car to the train to carry a sufficient supply of brakemen to provide for the frequent stops which often occur on a crowded road. Moreover, if it is necessary under the block system for a brakeman to go back until he meets the next train, it is far more necessary where the block system is not in use. It is a pity that the New York Railroad Commission should fall into such an absurd error in this matter, for it must inevitably weaken respect for its other more intelligent conclusions.

TESTS OF PAVING BRICK.

The use of brick for paving is now extensively practiced, and we have recorded a number of tests of paving brick, in our issue of March 30. The accompanying table shows the results of tests of 17 different makes of brick, carried out at Fostoria, O., in June, 1893, under the direction of Mr. John P. Ford, City Engineer.

Test of Paving Brick; Fostoria, O.

Quality.	Name and make of sample.	Weight. Before testing in rattler. Lbs.	Oz.	After testing six hours in rattler. Lbs.	Oz.	Loss in weight. Lbs.	Oz.	Percentage.	Weight after 49-hour absorption test. Lbs.	Oz.	Gain in weight. Lbs.	Oz.	Percentage.	Total percentage.
1	East Clayton	7	14¼	7	9	..	6¼	.0415	7	10	1		.0082	.0497
2	Canton shale repressed brick	7	4	6	14¼	..	5¾	.0300	6	15		¾	.0068	.0368
3	East Clayton 3-in. brick	8	6¼	7	15	..	7¼	.0512	8	0	1		.0075	.0587
4	John Porter Co. standard brick	7	¼	6	10	..	6¾	.0556	6	11	1		.0093	.0649
5	Toronto Fire Clay Co. brick	6	8¾	6	3	..	5¾	.0345	6	5	2		.0202	.0705
6	Canton shale block	10	0	9	5	..	11	.0687	9	5½		½	.0033	.0720
7	Canton Malvern repressed brick	6	9	6	2	..	7	.0436	6	3¾	1	¼	.0127	.0563
8	Bucyrus paver	7	4¼	6	11½	..	8¾	.0744	6	13	1	½	.0138	.0882
9	Canton Malvern standard brick	6	12¾	6	6	..	6¼	.0377	6	9¼	3	¼	.0318	.0695
10	Cant. Malv. blue granite block	10	1	9	2¼	..	11¾	.0916	9	2¼	0		.....	.0916
11	John Porter Co. mac. block	9	9	9	0	..	9	.0088	9	5	5		.0347	.0435
12	Hallwood block	8	9¾	7	12	..	13¾	.0925	7	12¾		¼	.0020	.0945
13	Akron standard brick	7	2¾	6	11½	..	6¾	.0390	6	15½	4		.0372	.0762
14	John Porter Co. repressed brick	7	½	6	8	..	8½	.0755	6	12	4		.0384	.1139
15	Parto block	8	6¼	7	8¼	..	14	.1042	7	10	1¾		.0115	.1157
16	Canton shale standard brick	7	4	6	2¼	1	1¾	.1537	6	2¼	0		.....	.1530
17	Buckeye standard brick	6	15	6	1	..	14	.1261	6	5	1		.0412	.1673

A "novel speed calculator," for checking time tables and regulating the speed of trains, is described by the London "Railway News" and highly praised as a late invention of Mr. H. C. Cusack, Assistant Locomotive Engineer of the Midland Great Western Railway. Judged by the description it is little more than a lithographed sheet 22 ins. square divided in one direction for time and in the other for distance, and to be used in connection with threads and pins in the manner familiar for years to American makers of time-tables. Its use is now practically obsolete in the United States.

The connection of Ceylon with the mainland of India by a railway over "Adams Bridge" is advocated in a pamphlet by Sir George Barclay Bruce, Past President of the Institution of Civil Engineers, and Chief Engineer of the Great South of India Railway. The distance from the island to the mainland is 60 miles, and 20 miles of this is covered by the so-called "Adams Bridge," an irregular ridge of rock and sand, partly dry at low water, and from one to two miles wide between surf lines. Sir George says that he believes this formation would permit the construction of a substantial roadbed, as the tide rises only 2 ft., and that in any event a viaduct of short spans of iron or steel would do the work required. The Madras "Mail," from which we take this item, while it fully discusses proposed land connections, does not say how the remaining 40 miles of water is to be passed, whether by ferry or otherwise.

Rapid transit is inaugurated in Paris by an underground extension of the Orleans Railway. This company owned a short line terminating in the extreme south of Paris, near the Observatory. This short line has now been extended about 1½ miles by a line mainly underground and terminating near the Pantheon, thus making it one of the most accessible of all the great Paris railways and accommodating an important local traffic. The tunnel is nearly completed and the line will probably be opened to traffic within the next year.

The total length of Russian railways in 1892 was 6,895 miles owned by the government, and 11,647 miles worked by private companies and individuals.

The plans for the torpedo boats for the U. S. battleships "Maine" and "Texas" are completed, and they are said to be the first boats of this class designed for the U. S. Navy. The two boats for the "Maine" will be 61⅜ ft. long, 9 ft. beam and 2 ft. 2 in. draft. The tonnage is 14.8 tons, while the boats for the "Texas" will be 2¼ tons smaller.

The following costly improvements are expected to be under way in New York by next spring: The Harlem River speedway, estimated cost $1,500,000; the 11th St. widening, $4,000,000; the new Harlem bridge and approaches, $2,000,000; Park Ave. improvements, $150,000; new City Hall, $4,000,000, and dock improvements, $3,000,000.

The assessment for corner sidewalks forms the subject of an opinion issued by the Corporation Attorney of St. Paul. He holds that the square formed at the corner by the intersections of the two sidewalks is properly a part of the sidewalks and should be paid for by the property owner and not by the city; as at present, under the classification of cross-walks. Where the interval between the sidewalk and the street proper is grassed and planted with trees, he holds that this boulevard is properly a part of the street and the walks across it, in continuation of the sidewalks, belong to the city and must be paved by the city as part of the crosswalks. The Corporation Attorney bases his decision upon the law which says that the expense and cost of making sidewalks shall be assessed in proportion to the number of lineal feet of a lot fronting upon the sidewalks. He claims that the property fronts upon this corner square within the meaning of the law, and that this square is essential to the completion of the sidewalks. Some opposition is expected from property holders to this interpretation of the law.

The sewers of Washington, D. C., to the end of the fiscal year of June 30, 1895, should have $5,000,000 expended upon them, according to the urgent recommendation of Captain Derby, assistant to the Engineer Commissioner, and the plans of the board of sanitary engineers appointed in 1891 by the late President Harrison to devise a new sewerage system. Captain Derby suggests a sewer loan to provide the funds required, as the work cannot be economically constructed piecemeal, and any delay subjects the city to the dangers of an epidemic or a repetition of the flood of 1889 in the low district of the city.

The managers of the World's Fair are already commencing to speculate as to the possible salvage from the $17,000,000 worth of buildings in Jackson Park. At one time it was supposed that $3,000,000 could be realized from the sale of the buildings and materials; but the general opinion now seems to be that there will be little left after the cost of tearing down and removing and restoring the park to its original condition has been paid for. There are about 30,000 tons of material in the several buildings, and it is estimated that there will be nearly 2,000,000 cu. yds. of rubbish to cart away.

The U. S. protected cruiser "Detroit," lately added to the navy, is 257 ft. long on load-line, 37 ft. extreme beam, 14½ ft. mean draft and has a displacement of 2,050 tons. She has made a speed trial of 18.7 knots with 6,000 h. p. developed. She has light armor and the following battery: Eight 5-in. rapid-fire, two 6-in. rifles, six 6-pdr. Hotchkiss guns, two 1-pdr. and two Gatling guns, with five tubes for launching automobile torpedoes. The "Detroit" is a sister ship to the "Montgomery" soon to be launched.

The length of geological time on our earth is placed at 45,140,000 years by Prof. Charles D. Walcott, of Washington, D. C., in his address to the geological section of the Am. Assoc. for the Advancement of Science, at its Madison meeting. He bases his conclusions mainly upon the Paleozoic sediments of the Cordilleran area, and estimates the several geological periods as follows, leaving out the Archean as doubtful: Cænozoic, 2,900,000 years; Mesozoic, 7,240,000; Paleozoic, 17,500,000; Algonkian, 17,500,000 years. Estimated at the rate of calcareous sediments now being formed, he calculated that it would require 600,000 years to form a deposit of limestone 22 ft. in thickness, and at this rate it would take 47,000,000 years to form the deposit of calcium carbonate in the Cordilleran area. But he reduces this period for possible change of special conditions and mechanical deposits as given above.

Three turbine wheels of 1,100 HP. each have been placed in the wheel pit of the Niagara Falls Paper Co., and will discharge into the tail race tunnel of the Niagara Falls Power Co. Provision is made for three more of the same capacity. The six shafts connected with these wheels will be 10 ins. in diameter and weigh 35,000 lbs. apiece. The penstock leading the water from the canal is about complete; it is 128 ft. long and 13½ ft. in diameter. R. D. Wood & Co. are the builders of the turbines and metal work, and 600 tons will be required in all.

CONSTRUCTION NEWS

RAILWAYS.

East of Chicago—Existing Roads.

CANADIAN GOVERNMENT RAILWAYS.—The department of railways and canals, Ottawa, has awarded the contract for steel rails for the Intercolonial Ry. to the amount of 2,500 tons to J. K. Hutchins, Montreal, and a similar quantity for the same road to Charles Cassils, Montreal. A contract for 1,000 tons for the Prince Edward Island Ry. and 500 tons for the Windsor branch has been awarded to W. H. Daunt, of England.

CHAUTAUQUA LAKE.—Press reports state that according to the present outlook this railway will have to be abandoned. The line is about 25 miles long and was opened for traffic in 1887. W. E. Griggs, Jamestown, N. Y., was appointed receiver in 1890.

CHICAGO & EASTERN ILLINOIS.—Concerning the proposed extension of this road to Louisville, Ky., recently referred to in these columns, a press report states as follows: This company is considering the matter of extending its line from Terre Haute, Ind., to the Ohio River, and unless matters turn out to suit it at the annual meeting of the Evansville & Terre Haute R. R. Co. the construction will soon be commenced, probably using the line surveyed to Mitchell, Ind., then on to Louisville. The building of this road would help the Kentucky & Indiana Bridge Co., and give Terre Haute a direct line to Louisville.

PHILADELPHIA & READING.—The Citizens' Association, Philadelphia, is urging that the tracks of this road be depressed in that city West from 15th St. to Girard Ave., and a tunnel constructed under Pennsylvania Ave. West of 21st St. This plan would do away with an elevated structure at Broad St. as well as with all the dangerous grade crossings West of Broad St. The estimated cost of the work is $5,000,000, against $1,500,000 for the elevated structure. It would also increase the company's yard space, and is reported as being favorably considered.

WILKES BARRE & EASTERN.—It is stated that this road will be opened for coal traffic this month between Wilkes Barre and Stroudsburg, Pa., a distance of about 60 miles.

Projects and Surveys.

MICHIGAN.—The Hillsdale correspondent of the Detroit "Free Press" states as follows: There is a prospect that the railway which was years ago projected from Mansfield, O., to Coldwater, Mich., and thence to Lake Michigan, at some point at or near Muskegon, may be constructed in the course of the next year. Parties are now engaged in looking over the line to ascertain the condition of its roadbed, etc. This road was surveyed from Mansfield to Allegan, and a great part of the grading was done, culverts and bridges were built and quite a stretch of the roadbed was made ready for the ties, when the work was stopped. A great part of this roadbed is in a condition to be used at once, and the parties who are looking into the matter propose to utilize the material on hand and push the work to completion at the earliest possible moment, provided they can secure control of the roadbed and franchise of the old company, which is long since dead. Camden and Montgomery are the only places in Hillsdale county through which the road will pass.

NEW YORK, NEW ENGLAND & NORTHERN.—At a meeting of the state railroad commission Sept. 18, A. A. McLeod, President, is reported to have given assurance that the necessary capital had been secured for the construction of this proposed road from Leggett's Point on the Harlem River in New York city to Brewster, a distance of about 50 miles, and that the

road would be built if the required permission were granted. This road would give the New York & New England R. R. an entrance into New York city. The hearing was adjourned one week.

WISCASSET & QUEBEC.—About ten miles of the proposed route for this road, referred to more fully in our issue of Sept. 7, have already been surveyed, and the work is being rapidly pushed. It is reported that the line will be narrow gage. Gen. Man., Geo. H. Crosby, Albion, Me.

Southern—Existing Roads.

ABBEVILLE & WAYCROSS.—It is reported that this road will be extended from Lulaville, Ga., south to Irwinville to connect with the Tifton & Northeastern, which was built in 1891 from Tifton northeast to Irwinville, a distance of 13 miles.

JACKSONVILLE, ST. AUGUSTINE & INDIAN RIVER.—Tracklaying has been commenced on the extension between Jupiter and Juno, Fla., according to reports.

MONTGOMERY, HAYNEVILLE & CAMDEN.—It is stated that stockholders are considering the construction of 30 miles of this proposed road from Camden, Ala. The line has been surveyed to Montgomery, a distance of 73 miles, and about 10 miles were graded nearly a year ago. John A. Milner, Engr., Camden, Ala.

STILLMORE AIR LINE.—This road has been completed and opened for traffic from Stillmore south to Collins, Ga., a distance of 20 miles, according to reports.

Northwest—Existing Roads.

GREAT NORTHERN.—The tracklayers on the extension from Sioux Falls to Yankton, S. Dak., reached Yankton Sept. 16 and will have the line ready for operation this week. An engine house having stalls for 16 locomotives will be built at that place, and it is reported that the road will at once be extended up the Missouri River to Charles Mix county.

Projects and Surveys.

LAKE SUPERIOR LUMBER CO.—This company is reported as about to build a logging railway to connect with the Chicago, St. Paul, Minneapolis & Omaha Ry. near White Birch, Wis., and to extend northward to the upper shore of Lake St. Croix.

Southwest—Existing Roads.

CHICAGO, ROCK ISLAND & PACIFIC.—A report from Altus, Okla., states that the engineers of this company have made a survey from Rush Springs, in the Chickasaw nation, through Fort Sill, and are now sounding the north fork of the Red River for a suitable crossing into Greer county. The route has already been inspected by contractors, and indications point to the early construction of the road.

HUTCHINSON & SOUTHERN.—A press dispatch from Hutchinson, Kan., states that this road will positively be extended through the county seat located by the government at Pond Creek, Okla. The work is being pushed as rapidly as possible, as stated in our issue of Aug. 3.

MISSOURI, KANSAS & TEXAS.—It is reported that the St. Louis extension, from Franklin to St. Louis, Mo., will be in operation within 60 days. The Burlington bridge across the Missouri River at Bellefontaine, which will furnish the St. Louis inlet, will be ready for traffic early in November.——A report from Hillsboro, Tex., states that the roundhouses and shops now at Alvarado, Tex., will soon be moved to Hillsboro, the city having offered 100 acres of land north of the city for their location.

ST. LOUIS, CAPE GIRARDEAU & FORT SMITH.—Engineers of this railway are surveying a line in Missouri from Cape Girardeau county through Perry, St. Genevieve and St. Francois counties. It will pass through the Flat River district and connect with the St. Louis, Iron Mountain & Southern near Irondale.

Projects and Surveys.

KANSAS.—A dispatch from Topeka, Kan., to the St. Louis "Globe-Democrat" states that capitalists at St. Joseph and Highland, Kan., are organizing a company to build a railway in Doniphan county from Highland to Ryan, a distance of 15 miles. Highland is at present without any railway facilities, and this short line is desired for the purpose of securing a connection with the Burlington & Missouri River system. The money is to be provided by the Doniphan county capitalists, assisted by the merchants of St. Joseph.

Rocky Mt. and Pacific—Existing Roads.

BURLINGTON & MISSOURI RIVER.—The Seattle, Wash., "Post Intelligencer" states that preparations are being made for the extension of this road to Puget Sound. It is now completed to the state line between Wyoming and Montana, near Billings, and a contract for a further extension has been let to Kilpatrick Bros. & Collins. Work may be resumed within two months, but if it should be postponed beyond that time it will certainly begin in the spring. The next important points at which the company is aiming are Helena and Butte, but steps have already been taken to secure terminals on the Sound. Agents of the road have been here during the summer and have looked over the ground and acquired property in both Seattle and Tacoma with that end in view. Engineering parties have also been in the Cascades making reconnaisances for the purpose of finding the best route through the range. Such strict secrecy has been observed as to the movements of the men and as to the plans of the company that no particulars have been obtainable and nothing is known as to what point will be selected as its Pacific coast terminus.

COLORADO MIDLAND.—It is reported that work on the extension of this road to Cripple Creek, Colo., will soon be resumed and the road completed at an early date.

DENVER & RIO GRANDE.—The grading for a two-mile spur to the United Coal Co.'s mine at Williamsburg, Colo., has been completed by Levy & Moore, the contractors, and the rails are now being laid.

NEVADA SOUTHERN.—The Nevada Southern Construction Co. has been incorporated by G. C. Manley, W. L. Beardsley and C. B. Mason, Denver, to carry on the work of building this road, now under construction from Blake, Cal., to Good Springs, Nev.; capital stock, $100,000. The first section of the road, between Blake and Summit, Cal., 30 miles, has been completed, as stated in our issue of Aug. 17.

Projects and Surveys.

OREGON.—The board of engineers on obstructions to navigation in the Columbia River between Three-Mile rapids and Celilo falls has recommended that a portage railway of standard gage be constructed on the south side of the river from Celilo to The Dalles, at an estimated cost of $454,390, and that whenever greater accommodations are required that a canal be constructed. The investigation was authorized by a provision in the last river harbor bill.

STREET RAILWAYS.

CLINTON, MASS.—The Clinton St. Ry. Co. has voted to extend its line to Acre, according to the conditions recently granted by the selectmen. The work will be commenced at once.

NEW HAVEN, CONN.—The selectmen have approved plans granting the Edgewood St. R. R. Co. permission to extend its line through Orange and Fountain Sts. in Westville, the road to be equipped for using electricity and to be in operation by Oct. 1, 1894.

SEA ISLE CITY, N. J.—It is reported that the new South Jersey Traction Co. contemplates making many additions to its road before next season, the most important of which is the construction of a branch to Cape May, with branches probably to Ocean City, Avelon, Wildwood, Anglesea and Holly Beach. It is thought that the Cape May road will run over the old roadbed of the Cape May & Tuckahoe R. R., which is graded its entire distance of 25 miles.

PEN ARGYL, PA.—The Pierce & Miller Engineering Co., contractors for the electric railway to East Bangor, as stated in our issue of Sept. 7, has awarded a contract for 12,750 ties, to be delivered within 60 days, to C. A. Meyers, Wind Gap.

PITTSTON, PA.—The Pittston Suburban Ry. Co. has sold the franchise for an electric railway through Jenkins township to the Wyoming Valley Traction Co. It is expected that the latter company will push the road to Wilkes-Barre on the east side to speedy completion.

SEWICKLEY, PA.—It is reported that the Coraopolis & Neville Island Electric St. Ry. will be extended to this borough. A bridge will be required across the Ohio River and the power house will be completed before winter sets in if possible.

WILKES BARRE, PA.—The People's Traction Co. has broken ground for an electric railway between Nanticoke and Glen Lyon, by way of Alden and Wanamie. It is stated that this line will be completed as soon as possible and that others are under consideration. Pres., K. M. Smith; Secy., T. D. Garman; Treas., J. M. Garman.

BALTIMORE, MD.—The Baltimore "Sun" states that the syndicate, including P. A. B. Widener and W. L. Elkins, Philadelphia, and Hambleton & Co., of this city, which is promoting the enterprise to connect Baltimore and Washington by a boulevard and electric railway, met Sept. 14 and decided to begin the work at once and to push it to an early completion. A corps of engineers has been started over the projected route to survey the line and report on the most practical route. It is claimed that most of the difficulties that have heretofore stood in the way of a rapid prosecution of this work have been removed and that the electric line between the two cities is an assured fact. The money for the enterprise, it is said, has been fully guaranteed, and that no money either for stock or bonds of the corporation will be solicited outside of the syndicate until the road is equipped and in successful operation. Several surveys have already been made for this line from Washington through the District of Columbia and part of Prince George's county in this state. The road will secure an entrance into Washington over the Eckington & Soldiers' Home electric line, and into this city over one of the lines of the Traction Co. as the owners of this company are the chief promoters of the new enterprise. The road will be double tracked and built in the latest and most approved manner. It will be designed to attain a speed of between 20 and 30 miles an hour and it is expected that the road will become popular with travelers.

WASHINGTON, D. C.—A bill has been introduced in the senate to incorporate the Washington & Benning St. Ry. Co. The road is to begin at the intersection of Maryland Ave. and Benning road and to extend to the southeastern boundary of the district, with several branch lines. The fare is to be 5 cts. and the company is to pay 2% of its gross earnings in lieu of taxes upon its property. All but one branch is to be completed within two years and the entire road in three years; capital stock, $300,000; incorporators, W. B. Thompson, H. J. Gray, W. E. Clark, Levi Woodbury and others.

BROOKSVILLE, FLA.—Asa D. Roberts is reported as interested in a projected electric railway to Bayport, a distance of 15 miles.

NATCHEZ, MISS.—The Natchez Transit Co. has been incorporated by Maurice Moses and others; capital stock, $250,000.

HENDERSON, KY.—Surveys are being made for a new electric railway, according to reports. Supt., John O'Brien.

MADISONVILLE, KY.—An electric railway to Earlington is proposed by some of the wealthy residents of these two towns.

AKRON, O.—The franchise for a street railway through Main and Furnace Sts. and to Cuyahoga Falls has been granted to R. J. Randolph, Cincinnati. The matter has been under consideration by the council several months.

DAYTON, O.—It is stated that the money needed by the Dayton Traction Co. to build the proposed electric railway from Harshmanville through this city to Miamisburg has now been secured and that the construction will soon be commenced. The necessary franchises and right of way were secured some time ago.

YOUNGSTOWN, O.—The Park & Falls Improvement Co. has decided to commence the construction of its electric railway this fall, provided the charter is secured, and to have the entire line in operation before spring, according to reports. The Westinghouse system will probably be used and the work all done by contractors. S. C. Grier, Chas. Dahlinger and Barton Grubbs are among the directors.

ALTON, ILL.—The board of trade has decided not to vote $600 to the St. Louis & Chicago Electric R. R. for a survey through this city, but to offer a cash bonus of $5,000 for the road to come here.

KIRKWOOD, MO.—The route of the proposed electric railway to Des Peres is being surveyed by B. E. Johnson, Ex-Co. Surv.

LOS ANGELES, CAL.—The board of supervisors has ordered that the franchise for an electric railway between this city and Pasadena be again advertised for sale to the highest bidder.

SAN FRANCISCO, CAL.—A press dispatch states that the proposed consolidation of leading street railways in this city will be accomplished in a few days under the name of the San Francisco Cable Ry. Co., with a capital stock of $16,000,000. The Market St. Cable Co. will hold the controlling interest or a proportion of stock of three out of ten shares.

TRURO, N. S.—A company has been incorporated to build an electric railway in this place. M. Dickie, F. A. Laurence, Wm. Craig and S. G. Chambers are interested.

GALT, ONT.—It is stated that the directors of the Galt & Preston St. Ry. Co. hope to change the motive power of the road from steam to electricity and to complete the line between this place and Berlin to connect with the Berlin & Waterloo St. Ry. Both passengers and freight would be carried.

SELKIRK, MAN.—Mayor Dagg and R. B. Cumming are interested in a projected electric railway to Winnipeg, a distance of 20 miles. A charter has already been obtained.

WINNIPEG, MAN.—G. H. Campbell, Man. Winnipeg Electric St. Ry. Co., is reported as stating that material has been purchased for extensions which will be made as soon as the plans have been approved by the council.

HIGHWAYS.

MASSACHUSETTS.—A boulevard is proposed from Manchester, N. H., to the Atlantic Ocean, following the bank of the Merrimac River. The board of trade of Haverhill has voted to petition the city to lay out the necessary roadway from the Methuen line along the bank of the river to Rock Village, the entire length of the municipality. F. E. Richards is a member of a committee appointed to confer with the boards of trade of other cities along the proposed boulevard with regard to the project.

NEW YORK.—The commissioners of highways of the town of Oyster Bay have directed Thomas U. Seaman, Glen Cove, to have the route of the proposed new road from Elm Ave., Glen Cove, to Brookfield, surveyed at once. The surveying is in charge of Isaac Coles.

BRIDGES.

BRADFORD, PA.—Bids are asked until Sept. 25 for the superstructure of an iron highway bridge, 60 ft. span, 16-ft. roadway and two 6-ft. sidewalks; also for about 170 cu. yds. stone abutments, as stated in our advertising columns. F. W. Dalrymple, Cy. Engr.

PETERSBURG, VA.—Bids are asked until Sept. 30 for the superstructure of a steel and iron bridge 90 ft. long. John W. Hays, Cy. Engr.

CLEVELAND, O.—The council has voted to reconstruct the superstructure, foundations and approaches of Columbus St. bridge over the Cuyahoga River.

LANSING, MICH.—The council has authorized the issue of $25,000 of bridge bonds.

WACO, TEX.—The committee is selecting a site for a new bridge to be built across the Brazos River at this place; estimated cost, nearly $100,000.

HALIFAX, N. S.—The dominion government has sent two engineers to make soundings for foundations for rebuilding the Dartmouth bridge. The bridge will be an iron structure on masonry piers.

CHAMBLEY, QUE.—It is reported that a steel and iron bridge will be built across the Richelieu River; estimated cost, $40,000.

NEWMARKET, ONT.—The town is reported as about to construct two steel bridges across the Holland River.

WINNIPEG, MAN.—The council of Fort Rouge will be asked to construct a bridge at Boundary St. this winter, according to the "Free Press."

WATER-WORKS.

BAR HARBOR, ME.—It is stated that the plant of the Bar Harbor Water Co. has been purchased by J. S. Kennedy, G. W. Vanderbilt and others, at $175,000.

BATH, ME.—The entire cost of changing the supply from Thompson's Brook to Nequasset Lake is estimated at $175,000, including the connection with Brunswick.

MANCHESTER, N. H.—The contract for two Manning boilers for the new pumping station has been awarded to the Atlantic Works, East Boston, Mass., at $2,100. It is reported that plans are being prepared for a new reservoir, for which bids will soon be asked.

BENNINGTON CENTER, VT.—The Bennington Water Co. has voted to extend its mains to this village.

AMHERST, MASS.—The Amherst Water Co. has decided to build the dam of the new reservoir 12 ft. high so as to overflow about five acres.

BOSTON, MASS.—The water board will receive bids until Sept. 28 for excavating and disposing of 15,000 cu. yds. of stripping in basin 6, Ashland.

CANTON, MASS.—A meeting was held Sept. 19 to consider the question of an additional supply. Bonds are proposed.

MALDEN, MASS.—The council is considering an appropriation of $3,000 for experimenting with a view to securing an additional supply.

METHUEN, MASS.—The contract for stone work at the reservoir has been awarded to Wm. S. Marsh, Lawrence, and that for 40 wells to B. F. Smith & Bro., Boston, at $4,500.

NEWBURYPORT, MASS.—The committee has been authorized to employ an engineer to investigate the question of a supply and the cost of proposed works.

SALEM, MASS.—Lucian A. Taylor has reported in favor of a reservoir on Miles River and the conducting

of the water into Wenham Lake, the present source of supply.——The aldermen have appropriated $19,000 for a new main in Canal St.

SAUNDERSVILLE, MASS.—John E. McClellan and S. T. Smith, Supt. Grafton Water Co., Grafton, have contracted to put in works, according to reports.

SOUTHBRIDGE, MASS.—A. C. Moore has prepared plans for an additional reservoir 1¼ miles southwest of the present reservoir of the Southbridge Water Supply Co. and 50 ft. above it. Bids for the work were received Sept. 20.

PROVIDENCE, R. I.—The contract for a 15,000,000-gallon pumping engine for the Pettaconsett station has been awarded to the Henry R. Worthington Co., New York. Bids were also received from the Edward P. Allis Co., Milwaukee; Holly Mfg. Co., Lockport, N. Y.; Groshon High Duty Pumping Engine Co., New York; and the Geo. F. Blake Mfg. Co., Boston. The bids were so close that a selection was made only after a careful inspection of the more prominent pumping plants in the country.

KENMORE, N. Y.—The mains of the Tonawanda City Water-Works Co. are being extended to this village.

LE ROY, N. Y.—The village has contracted for 1,300 ft. 6-in. pipe, which will soon be laid.

NEWTOWN, N. Y.—The Citizens' Water Supply Co. is reported as negotiating for land near Whitefoot for the location of its proposed plant.

RICHMONDVILLE, N. Y.—An election was held Sept. 20 to vote on an issue of bonds for $16,000 for the construction of works.

ELIZABETH, N. J.—The Lorraine Water Co. is being organized to put in works, the supply to be taken from the mains of the Union Water Co.; capital stock, $10,000.

NEWARK, N. J.—It is reported that work will soon be commenced by the city upon a large storage reservoir at South Orange, for which plans are now being prepared.

ORANGE, N. J.—Bids are asked until Oct. 2 for a 1,500,000-gallon pumping engine at Campbell's Pond. Thos. Dowd, Supt.

SOUTH AMBOY, N. J.—John Scully, Chn. Bd., informs use that bids will probably be received next month for works estimated to cost $35,000. The supply will be pumped to a stand-pipe; population, 5,000.

LOCK HAVEN, PA.—The council has directed that the clerk receive bids until Sept. 25 for trenching, pipelaying, furnishing pipe, lead, etc., for the new supply, referred to in our issue of Sept. 7; estimated cost, $30,000 to $40,000. Voorhees & Witmer, Engrs., Buffalo, N. Y.

MEDIA, PA.—The committee has been directed to advertise for bids for a 4-in. pipe in Jefferson St.

WEST CHESTER, PA.—The committee is reported as securing prices for an additional pump.

WYALUSING, PA.—The Wyalusing Water Co. has been incorporated by John W. Stroud, Black Walnut; L. A. Patterson, Carbondale; John W. Chamberlain, Wyalusing, and others; capital stock, $20,000.

WASHINGTON, D. C.—Specifications are being prepared for connecting the Georgetown service with the proposed reservoir at Fort Reno, for which land has recently been obtained.

FRANKFORT, KAN.—The local papers are reported as urging the necessity of works.

SIOUX FALLS, S. DAK.—The mayor has recommended that a committee be appointed to consider the purchase of the works.

LARAMIE, WYO.—The mayor has appointed a committee to advertise the sale of $100,000 of bonds for works.

FORT BENTON, MONT.—The council has voted to purchase the local works.

ST. LOUIS, MO.—The board of public improvements will receive bids until Nov. 14 for two 30,000,000-gallon pumping engines at the Chain of Rocks station.

ROCK SPRINGS, TEX.—The Rock Springs Water Supply Co. has been incorporated by W. P. Pulley, J. V. James, J. C. Wren and others; capital stock, $15,000.

UNIONVILLE, MO.—It is reported that works will be put in.

BOULDER, COLO.—At the election Sept. 12 the citizens voted in favor of $50,000 of additional bonds to complete the works. The proposed addition will require 5,755 lin. ft. of tunneling through solid rock, according to reports, and the work will be commenced as soon as possible.

SEATTLE, WASH.—The board of public works is considering the purchase of a 2,500,000-gallon pumping engine and two additional boilers.

COLTON, CAL.—The city is considering a new supply, according to reports.

POMONA, CAL.—The city is considering an offer of the Citizens' Water Co. to sell its plant for $46,600.

SAN FRANCISCO, CAL.—The Spring Valley Water Co. is reported as planning to build a 6,000,000-gallon reservoir.

SANTA MONICA, CAL.—The water company is laying 3,500 ft. 12-in. pipe and making other improvements to secure an increased supply, according to reports.

YUMA, ARIZ.—A. B. Smith, San Diego, Cal., has petitioned for a franchise for works.

VANCOUVER, B. C.—Bids are asked until Oct. 10 for a quantity of cast iron pipe, according to reports. Thos. P. McGuigan, Cy. Clk.

ARTESIAN WELLS.

ENNIS, TEX.—The city is investigating the feasibility of boring artesian wells.

IRRIGATION.

NEW COMPANIES.—Rio Grande Dam & Irrigation Co., Las Cruces, N. Mex.; $5,000,000.——La Huerta Co., Eddy, N. Mex.; $100,000; to construct irrigating ditches, etc.——Mulberry Irrigation & Land Co., Dodge City, Kan.; $10,000; J. G. Fonda, Bucklin; J. M. Burson and others, Dodge City.

CONTRACT PRICES.

SEWERS.—Laconia, N. H.—Wm. Nelson, Supt. Sewers, informs us that the contract for sewers, recently noted in these columns, has been awarded to (6) Everson & Liddle, Providence, at $37,192, the other bids being as follows: 1, Dacey & Taylor, Boston, $51,350; 2, Herbert Tate, New York, $48,983; 3, F. E. Shaw, Providence, $42,882; 4, Frank L. Allen, Worcester, Mass., $41,908; 5, J. M. Brosnan, Westfield, Mass., $41,979. The prices were as follows:

	Max. cut. ft.	Av. cut. ft.	1. $	2. $	3. $	4. $	5. $	6. $
15-in. sewer..... 7,845 ft....	23.5	12.66	2.50	2.87	2.00	1.90	2.10	1.80
12 " " ..... 480 " ...	8.	4.75	.74	.81	.70	.60	.60	.60
10 " " ..... 1,805 " ...	12.	7.64	.93	.82	.80	.80	.62	.60
8 " " ..... 8,815 " ...	11.	6.95	.80	.64	.70	.62	.62	.50
6 " " ..... 20,335 " ...	9.5	6.40	.67	.48	.50	.50	.50	.40
15-in. Y branches..... 314.....	....	....	1.60	2.13	.90	1.10	1.25	1.40
12 " " ..... 19.....	....	..	1.10	1.54	.80	.76	1.00	1.00
10 " " ..... 72.....	....	....	....	.85	1.19	.50	.59	.75	.75
8 " " ..... 353.....	....	....	....	.60	.87	.40	.41	.75	.50
6 " " ..... 814.....	....	....	....	.40	.71	.30	.29	.65	.35

DREDGING.—San Francisco, Cal.—Maj. W. H. Heuer, U. S. Engineer Office, has awarded the contract for dredging a cut-off at Twenty-one Mile Slough, in San Joaquin River, to the San Francisco Bridge Co., at 8.74 cts. per cu. yd. Other bids were 10 and 11 cts. per cu. yd.

CEMENT WALKS.—Chicago, Ill.—The West Park board has awarded a contract for about $4,000 worth of cement sidewalks to the Barber Portland Cement Paving Co., at 13½ cts. per sq. ft.

RIPRAP PAVING AND BROKEN STONE. Boston, Mass.—The water commissioners have opened the following bids for (1) 5,350 cu. yds. riprap, (2) 1,938 cu. yds. paving, and (3) 1,667 cu. yds. broken stone on the proposed new dam No. 6, at Southboro:

	1	2	3
James Hegan	$1.37½	$2.87½	$1.67½
Augustus Saucier	1.95	5.50	2.25
Neil McBride	1.00	4.00	2.00
Thomas F. Maney & Co.	1.75	2.95	2.00
David Hall	2.67	3.87	1.97
John Perry	1.25	2.24	1.87
O'Connor & White	3.00	3.00	1.75
Newell & Snowling	2.00	4.00	1.00

SEWERS.

PLYMOUTH, MASS.—The contract for 7,750 lin. ft. 24 to 8-in. pipe sewer and about 1,300 lin. ft. 14-in. cast iron submerged outlet sewer has been awarded to F. T. Ley & Co., Springfield, at $11,714.

WOBURN, MASS.—The commissioners have decided to recommend that contracts for material be awarded this winter and that the work of construction be commenced early next spring. The main sewers will probably be done by contract.

BUFFALO, N. Y.—The board of public works has been directed to construct several brick and tile sewers.

NEWBURGH, N. Y.—Bids are asked until Oct. 3 for a brick, cast iron pipe and vitrified pipe main sewer, as stated in our advertising columns. D. J. Coutant, Cy. Clk.

NEW YORK, N. Y.—Bids are asked until Sept. 26 for four sewers and until Oct. 3 for three sewers. L. F. Haffen, Comr. St. Impvts., Wards 23 and 24.

NORTH TONAWANDA, N. Y.—Bids are asked until Oct. 3 for 5,000 lin. ft. 36 to 63-in. brick sewer, average cut 8 ft., and 13,000 lin. ft. 10 to 30-in. pipe sewer, average cut 7 to 8 ft.; estimated cost, $60,000. T. W. Barrally, Cy. Engr.

M'KEESPORT, PA.—The city engineer has been instructed to advertise for bids for certain sewers.

NEW CASTLE, PA.—Bids are asked until Sept. 25 for the House St. lateral sewer. Frank Tidball, Cy. Clk.

SANDUSKY, O.—The council has voted to construct a sewer in Jackson St.

NEW ALBANY, IND.—The commercial club is reported as corresponding with Alexander Potter, New York, with regard to plans for a complete sewerage system for the city.

RED WING, MINN.—The council is considering the advisability of commencing work on the proposed system this fall.

DUBUQUE, IA.—The city engineer has been directed to prepare plans for sewers in certain streets.

		1. $	2. $	3. $	4. $	5. $	6. $
Small flush tanks	33	75.00	67.50	90.00	65.00	65.00	75.00
Large " "	1	300.00	300.00	300.00	275.00	125.00	300.00
" " "	1	150.00	150.00	200.00	160.00	100.00	125.00
Manholes	39	40.00	55.00	45.00	50.00	40.00	45.00
Drop manholes	7	50.00	63.00	60.00	55.00	45.00	90.00
Lamp holes	100	7.00	5.75	7.50	5.00	10.00	10.00
4-in. drop connections	100	5.00	3.00	4.00	6.00	5.00	7.00
6-in. drain tile	1,000 ft.	.20	.12	.12	.20	.20	.15
4 " " "	1,000 "	.15	.10	.10	.18	.18	.10
3 " " "	3,000 "	.14	.08	.08	.15	.16	.0
Rock excavation	200 cu. yds.	5.50	4.00	5.50	5.50	3.00	4.0

VALDOSTA, GA.—An artesian well flowing 12,000 gallons per hour has been sunk and a complete system of works will now be put in, according to reports.

KNOXVILLE, TENN.—The Knoxville Water Co. is reported as planning important improvements.

ATHENS, O.—The citizens have voted in favor of the proposition of C. E. Coon & Co., Upper Sandusky, to put in works, at a rental of $3,000 per annum.

NORWALK, O.—J. A. Wagner, Dayton, has been investigating a supply for the city from the wells at Hartland.

CORYDON, IND.—It is reported that a private company is being organized to put in works.

GREENFIELD, IND.—At an election Sept. 12 the citizens voted in favor of municipal works.

BELDING, MICH.—Bids are being asked for works estimated to cost $5,800, according to reports.

IRONWOOD, MICH.—The council has voted to purchase the local works.

SAULT STE. MARIE, MICH.—The following lowest bid was received Sept. 14: J. W. Pearl, Benton Harbor, water tower, complete, $11,000; steel tank, in place, and iron ladders, $3,500; water tower, complete excepting steel tank, $7,500; intake pipe, crib and wall, complete, $14,000; well, complete, $1,000; intake pipe and crib, complete, in place, $13,000.

GLENCOE, ILL.—Plans for new works are being prepared by W. S. Shields, Title and Trust Bldg., Chicago.

MOUND CITY, ILL.—Bids are asked until Sept. 30 for works, according to reports. M. F. Browner, Cy. Clk.

QUINCY, ILL.—The council has voted to call an election within 60 days to vote on a proposition for the city to construct works.

ST. ANNE, ILL.—Steps are being taken to issue bonds for works.

BARRON, WIS.—The city has voted to issue bonds for $4,600 for works.

WINONA, MINN.—The council has decided to build an intake pipe into the river to secure a supply when that from the wells is inadequate or impure; estimated cost, $5,000.

Martin's Ferry, O.—The city council has awarded Sewers, informs us that the contract for sewers, recently designed by Alexander Potter, New York, to T. J. Stringer, Portland Station, and Caleb & Conture, Bridgeport. Mr. Stringer bid $1.25 per lin. ft. for furnishing and laying 15-in. pipe, average cut 10 ft. The bid of Caleb & Conture for furnishing and laying pipe, including Y's, was as follows: 6-in. pipe, 7 and 9-ft. cut, 25 and 29 cts. per lin. ft., respectively; 8-in., 56 and 66½ cts.; 10-in., 61 and 68½ cts.; 12-in., 65½ and 73½ cts.; 15-in., 9-ft. cut, 80½ cts. These prices include all trenching and backfilling, and the excavation will be through gravel which will require careful shoring. On account of the close proximity of the sewer pipe works, however, the cost of the material will be somewhat reduced. The construction has already been commenced.

Holyoke, Mass.—The contract for 500 lin. ft. 53-in. and 800 ft. 48-in. brick sewer, in Elmwood, has been awarded to Lynch Bros., at $13 per 1,000 brick, the other bids being as follows: Geo. W. Richards, $14 with Rosendale cement, or $16 with Portland; Baker & O'Connor, $13.40; O'Connell & Goddard, $14.25; Cavanaugh, Verrill & Sullivan, $13.40.

BRICK PAVING.—Canal Dover, O.—Bids were opened Sept. 15 for 13,323 sq. yds. brick paving, the lowest being as follows: Gardner & Barnett, Jamestown, paving complete, $1.23 per sq. yd. for Canton shale and $1.33 for repressed, with 12 cts. off if sand filler is used instead of tar filler; old curb relined, 3 cts. per lin. ft.; redressed, 12 cts.; new curb, 40 cts.; circles, 50 cts.; abutment, 40 cts.; 4-in. tile, 8 cts.; 12-in. sewer, 50 cts.; 15-in., 60 cts.; 18-in. 75 cts.; brick in repairs, $10 per M. This firm bid $1.17 per sq. yd. for standard fire brick, but the lowest bid for fire brick was that of Rosser & Hall, Bellaire, at $1.07 for standard and $1.16 for repressed fire brick, with 15 cts. off for sand filler, the other price being as follows, the items being the same as in the preceding: 15 cts., 15 cts., 32 cts., 50 cts., 35 cts., 10 cts., 55 cts., 65 cts., $1, $12. L. E. Chapin, Consult. Engr., Canton.

PIPE.—St. Louis, Mo.—The contract for 5,475 tons cast iron pipe has been awarded by the water department to the Chattanooga Foundry & Pipe Co., at $19.40 per ton. The lowest bid for this contract a few weeks ago was $24.90 per ton, according to reports.

SIOUX CITY, IA.—The city engineer has been instructed to advertise for bids for a brick sewer estimated to cost $50,000 to $75,000. The sewer will be nearly 6 ft. in diameter and about 12,000,000 brick will be required in the work.

OMAHA, NEB.—The council has voted to issue $75,000 of bonds for sewers and $50,000 for paving.

DALLAS, TEX.—The council has voted to issue $50,000 of 5% 30-year bonds for a system in East Dallas.

SAN FRANCISCO, CAL.—The engineers have presented plans for work estimated to cost about $30,000.

SAN LEANDRO, CAL.—An election was held Sept. 19 to vote on an issue of bonds for $10,000 for an outlet sewer to the bay.

MONTREAL, QUE.—Bids are asked until Sept. 27 for sewers in three streets. P. W. St. George, Cy. Surv.

STREETS.

LAWRENCE, MASS.—The county commissioners have decided to have Broadway widened from the north canal bridge to the Merrimac River bridge.

NEWTON, MASS.—Both branches of the council have passed the order authorizing the city to borrow $100,000 for the proposed boulevard, and the work will soon be commenced, according to reports.

PLYMOUTH, MASS.—Plans are being prepared for widening Middle St. in accordance with a bequest of $12,000 to the town for this purpose.

SALEM, MASS.—The following bids were received for constructing the Harmony Grove St.: H. Scott, Tuttle, Swampscott, $13,552; T. F. Maney & Co., Quincy, $14,900; Bates, Touret & Welch, Salem, $14,945; Mr. Heath, Lynn, $15,176; J. Sheehan, Lynn, $15,500; Jos. M. Parsons, Salem, $15,919; Peterson, Hamilton & Balcomb, Salem, $16,578.

NEW YORK, N. Y.—Plans are being prepared for the first mile of the proposed Harlem River speedway, and the work will probably be advertised within a few weeks.——Bids are asked until Oct. 3 for paving in two streets with granite blocks. L. F. Haffen, Comr. St. Impvts., Wards 23 and 24.

ERIE, PA.—Bids are asked until Sept. 28 for repaving in State St. with asphalt. Geo. Platt, Cy. Engr.

M'KEESPORT, PA.—It is stated that all damages have been adjusted for extending Market St. about a mile.

PITTSTON, PA.—The council is considering the paving of several streets.

YORK, PA.—The special committee has recommended that a loan of $100,000 be made for paving.

NORFOLK, VA.—The council has apprpriated $7,900 for improving Charlotte St.

PLEASANT RIDGE, O.—Bids are asked until Oct. 6 for macadamizing Ridge Ave. F. D. Acomb, Vil. Clk.; J. M. Harper, Engr., Cincinnati.

ST. BERNARD (P. O., Ludlow Grove), O.—Bids are asked until Oct. 5 for macadamizing Leonard Ave. J. G. Overman, Clk.

AURORA, ILL.—The council has voted to pave North Lake St. with brick.

PEORIA, ILL.—Bids are asked until Sept. 28 for 8,170 sq. yds. brick paving, as stated in our advertising columns. Jacob A. Harman, Cy. Engr.

ISHPEMING, MICH.—The council has decided to spend $5.000 upon street improvements to give work to the unemployed.

TORONTO, ONT.—The city engineer has decided to advertise for bids for paving College St., from Bathurst to Dufferin St.

ELECTRIC LIGHT AND POWER.

NORTH ATTLEBORO, MASS.—The committee to secure a municipal lighting plant for this town is reported as ready to contract for the building, which will be of brick, 100 × 55 ft., and built as an addition to the pumping station.

PHILADELPHIA, PA.—Bids are asked until Oct. 2 for an electric light plant at the state asylum for the insane, at Wernersville. John M. Reynolds, Secy. Comm., care of Rankins & Kellogg, architects, 1001 Chestnut St.

LE ROY, ILL.—It is reported that a company is being organized to enlarge and improve the electric light plant in this city. Address L. A. Crumbaugh.

MOUND CITY, ILL.—Bids are asked until Sept. 30 for lighting the streets by electricity. M. F. Browner, Cy. Clk.

BASTROP, TEX.—It is stated that John Andrewarth will put in an electric light and power plant in connection with the proposed water-works.

NEW COMPANIES.—Lewis Electric Co., Jersey City, N. J.; $1,000,000; I. N. Lewis, Rosebank, N. J.; V. H. Bridgman and W. S. Fanshawe, Westchester, N. Y.——Electric Improvement Co., Jersey City, N. J.; $10,000; R. Ashley, C. J. Shepard, Philadelphia; F. Bell, Jersey City.——LeRoy Electric Light, Power Heating Co., LeRoy, Ill.; $10,000; L. A. Crumbaugh, A. J. Keenan, L. A. Reynolds.——Gladstone Electric Light Co., Minneapolis, Minn.; J. W. Kendrick and John Wood, Minneapolis; E. S. Tice, Gladstone, Mich. ——Elliott Electric Co., Cleveland, O.; increase of capital stock from $40,000 to $75,000 and name changed to Elliott-Lincoln Electric Co.

MISCELLANEOUS.

LOCK GATES.—Ottawa, Ont.—Bids are asked until Sept. 28 for five pairs of lock gates at the Sault Ste. Marie Canal. J. H. Balderson, Secy. Dept. Rys. and Canals.

RAILING.—Brooklyn, N. Y.—Bids are asked until Sept. 27 for two lines of railing on the New York approach of Brooklyn bridge. C. C. Martin, Ch. Engr.

LEVEE WORK.—Vicksburg, Miss.—Bids will soon be asked for building Reid levee, in Madison parish, La. This levee is 5½ miles long and 700,000 cu. yds. of work will be required.

New Orleans, La.—Bids are asked until Sept. 25 for 15 contracts. L. D. Martin, Secy. Comrs. Lafourche Basin Levee Dist.

Vidalia, La.—Bids are asked until Sept. 25 for five contracts. W. H. Shields, Secy. Comrs. Fifth La. Levee Dist.

BUILDINGS.—New York, N. Y.—The armory board will receive bids until Oct. 4 for the erection of an armory building on the east side of Madison Ave., extending from 94th to 95th St.

Lansing, Mich.—The council has appointed a committee to secure options on available sites for a proposed new city hall estimated to cost $60,000.

PARK IMPROVEMENTS.—Oakland, Md.—We are informed by P. J. Bourchier that plans have been approved for a new lake at Moutain Lake Park, and that the construction will soon be commenced. The plans were prepared by J. J. Whitstone and include a lake covering an area of about 20 acres with a minimum depth of 3 ft. of water and surrounded by a 20-ft. driveway. The association is also considering the construction of a dam which by widening the present channel would afford boating for a distance of 2,000 ft. and would furnish water for flushing the channel below the dam to carry off the accumulations from the sewers.

Haverhill, Mass.—The board of trade has voted that the city should appropriate $250,000 for park purposes in connection with the proposed boulevard along the Merrimac River, the land between the boulevard and the river to be set apart for a park.

INDUSTRIAL NOTES.

LOCOMOTIVES.—The Baldwin Locomotive Works, Philadelphia, has an order for a large number of locomotives for the Metropolitan Elevated R. R., of Chicago.

STEEL PLANT.—Ground was broken at Ashtabula, O., Sept. 15 for the steel plant to be established 1¼ miles outside of the city limits by the Ashtabula Steel Co. The contract for the grading and foundations has been awarded to Keeling, Ridge & Co., Pittsburg. A side track from the New York, Chicago & St. Louis Ry. will be commenced this week and it is hoped to have the plant ready for operation by next May. The capacity when completed is reported as to be 2,000 tons of steel billets per day.

THE BELLEVILLE STEEL CO., Belleville, Ill., is about to be reorganized and it is expected that work will be resumed at the company's plant early next month, giving employment to about 900 men. The affairs of the company have been in the hands of receivers since last June.

SIGNALS.—The Illinois R. R. & Warehouse Co. has ordered an interlocking plant put in at 67th St., Chicago, at the crossing of the Illinois Central with suburban tracks, and one at Weldon, at the crossing of the St. Charles Air Line with the Illinois Central.

STONE CRUSHER, ETC.—The city council of Durham, N. C., is negotiating for the purchase of a boiler, engine, crushing machinery, etc., preparatory to making street and road improvements.

STREET SWEEPER.—The city council of Williamsport, Pa., is reported as considering the purchase of a street sweeper for use on the newly paved streets.

NEW COMPANIES.—Wickes Refrigerator & Car Co., Chicago, Ill.; $50,000; W. H. Wickes, W. R. Omehundre, J. J. Coudron.——American Steel Bolster Co., Granite City, Madison Co., Ill.; $500,000; E. F. Goltra, R. J. Whitney, J. G. McRoberts.——City & County Gas Co., Chicago, Ill.; $30,000,000; H. C. Rew, N. A. McClary, C. D. Hauk.——Trinidad Bituminous Asphalt Co., Jersey City, N. J.; $100,000; M. B. Mantewson, New York; A. F. Swan, Bayonne; A. S. Badgey, Montclair.——E. V. Johnson Co., Chicago, Ill.; $50,000; Mfg., contracting, etc.; E. V. Johnson, H. L. Burnham, O. T. Lindroth.——Roche Engineering Co., Chicago, Ill.; increase of capital stock from $5,000 to $25,000.

SANITARY DISTRICT OF CHICAGO.

SPECIAL NOTICE TO CONTRACTORS.

Notice is hereby given that the special contract made on Aug. 30, 1893, with McArthur Brothers' Company, for the completion of river diversion work on Sections 2, 3 and 4 of the Main Channel of this District, IN NO WAY AFFECTS OR HAS ANY BEARING ON THE RELETTING OF THE SAID SECTIONS now being advertised, bids for which are to be opened on Oct. 4, 1893.

THE SANITARY DISTRICT OF CHICAGO,
By FRANK WENTER,
President of its Board of Trustees.
Attest: THOS. F. JUDGE,
Clerk of the Sanitary District of Chicago.
Chicago, Sept. 6, 1893. 37-3t

Proposals for Excavating.

SANITARY DISTRICT OF CHICAGO. —TO CONTRACTORS.

Sealed proposals addressed to the Board of Trustees of the Sanitary District of Chicago and indorsed

"Proposal for Excavating a Portion of the Main Drainage Channel" will be received by the Clerk of the said Sanitary District at Room H, Rialto Building, Chicago, Ill., until 12 m. (standard time) of Wednesday, the 4th day of October, 1893, and will be publicly opened by the said Board of Trustees at the regular meeting held that day or at a special meeting called for that purpose.

The work for which the said tenders are invited is the excavation of that portion of the main drainage channel for the said Sanitary District, between Willow Springs and Joliet, Ill., known as contract sections two (2), three (3) and four (4), and consists in all of about 1,484,800 cubic yards of rock, of about 2,179,500 cubic yards of earth, the building of about 76,466 cubic yards of dry rubble walls.

Each of said sections will be treated as a separate contract in canvassing the proposals and making awards. As all awards will be made by individual sections, each bidder must make prices for each section separate and distinct from every other.

Each proposal must be accompanied by a certified check or cash to an amount equal to $3,000, multiplied by the number of sections bid upon.

All certified checks must be drawn on some responsible bank doing business in the city of Chicago, and be made payable to the order of the Clerk of the Sanitary District of Chicago. Said amount of $3,000 for each section will be held by the Sanitary District until all of said proposals have been canvassed and contracts awarded and signed, the return of said check or cash being conditioned upon any bidder to whom an award of any portion of said work may be made appearing within ten days after notice of such award being given, with bondsmen, and executing a contract with the Sanitary District for the section or sections of said work so awarded, and giving a bond satisfactory to said Board of Trustees for the fulfillment of the same in the amount of $100,000 for each section of work awarded him.

All proposals must be made upon blank forms furnished by the Sanitary District and must give the price for each separate item of work.

The bids will be compared on the basis of the engineer's approximate estimate of quantities, which will be furnished with copies of the specifications.

No proposal will be considered unless the party making it shall furnish evidence satisfactory to the Board of Trustees of his ability to do the work, and that he has the necessary pecuniary resources to fulfill the conditions of the contract, provided such contract shall be awarded him.

Bidders are required to state in their proposals their individual names and places of residence in full.

Specifications and plans may be seen at the office of the Chief Engineer, Rialto Building, Chicago, Ill.

The said Board of Trustees reserves the right to reject any and all bids.

THE SANITARY DISTRICT OF CHICAGO,
By FRANK WENTER,
President of its Board of Trustees.
Attest: THOMAS F. JUDGE, Clerk.
Chicago, Ill., Aug. 5, 1893. 32-8t

TREASURY DEPARTMENT, Office Supervising Architect, Washington, D. C., September 19, 1893.—Sealed proposals will be received at this office until 2 o'clock p. m. on the 12th day of October, 1893, and opened immediately thereafter, for all the labor and materials required for roof sheathing, slate and copper work of roof, down and drain pipes, etc., for the U. S. Custom House and Post Office building at Newark, New Jersey, in accordance with the drawings and specification, copies of which may be had at this office, or the office of the Superintendent at Newark, New Jersey. No convict labor or any product of convict labor will be allowed in the work. Each bid must be accompanied by a certified check for a sum not less than 2% of the amount of the proposal. The right is reserved to reject any or all bids and to waive any defect or informality in any bid should it be deemed in the interest of the Government to do so. All proposals received after the time stated will be returned to the bidders. Proposals must be enclosed in envelopes, sealed and marked. "Proposal for Roof Sheathing, Slate and Copper Work of Roof, Down and Drain Pipes, Etc., for the U. S. Custom House and Post Office, at Newark, New Jersey," and addressed to JEREMIAH O'ROURKE, Supervising Architect. 38-2t

PROPOSALS FOR SEWER CONSTRUCTION.

SEALED bids for building a storm water sewer on 12th, 13th, Dale and 17th streets will be received by the City Clerk of Sioux City, Iowa, until 8 o'clock p. m. Tuesday, Oct. 10, 1893.

There will be about 1,200 feet of 3 ft. 4 inch, 300 feet of 4 ft. 6 inch, and 3,300 feet of 6-foot brick sewer and about 500 feet of 12, 15 and 18-inch pipe sewer, about 50 brick inlets and 15 manholes.

Plans can be seen and specifications and bidding blanks can be obtained at the office of the City Engineer.

A bond in the sum of 40% of the amount bid, with two acceptable sureties, one to be a resident of Sioux City, must accompany each bid.

Payment will be made in "Sewer Bonds" running two, three, four and five years, bearing interest at the rate of 6%.

The right is reserved to reject any or all bids.

(Signed) KNUDE SUNDE,
38-1t Chairman Sewer Committee.

NOTICE TO SEWER CONTRACTORS.

NEWBURGH, N. Y., SEWERS.

SEALED PROPOSALS will be received at the City Clerk's office until 5 o'clock p. m. of Tuesday, Oct. 3, 1893, for the construction of a main trunk sewer from the Hudson River to Haines' Cross Road, as follows:

About 378 lineal feet plank sewer, 4 ft. 0 in. × 4 ft. 6 in.

About 900 lineal feet brick sewer, 3 ft. 0 in. × 4 ft. 6 in.

About 1,350 lineal feet cast iron pipe sewer, 4 ft. 0 in. diameter.

About 900 lineal feet brick sewer, 5 ft. 0 in. diameter.

About 5,850 lineal feet brick sewer, 4 ft. 6 in. diameter.

About 2,570 lineal feet vitrified pipe sewer, 2 ft. 0 in. diameter.

Plans can be seen and form of proposal and specifications obtained at the office of City Clerk.

No bid will be considered unless made out on the form of proposal furnished, with all the conditions filled in, and accompanied with a certified check or cash deposit to the amount of $1,000, made payable to the City of Newburgh, as a forfeit in case the contractor whose bid is accepted should fail to sign the contract and begin the work within thirty days after the contract is awarded.

The Common Council hereby reserves the right to reject any or all proposals.

D. J. COUTANT, City Clerk.
Newburgh, N. Y., Sept. 12, 1893. 37-2t